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South-Eastern Europe Journal of Economics

THE OFFICIAL JOURNAL OF THE ASSOCIATION OF ECONOMIC UNIVERSITIES
OF SOUTH AND EASTERN EUROPE AND THE BLACK SEA REGION

Vol 21 | No 1 | SPRING 2023

Thessaloniki, Spring 2023

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Articles

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CONSUMER PRIORITIES IN FOOD QUALITY CHARACTERISTICS: EMPIRICAL FINDINGS FROM TÜRKIYE[*]

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Abstract

This study investigates the prioritization of food quality characteristics among Turkish consumers and explores the influence of socio-demographic factors on these preferences. The findings reveal that healthiness, freshness, and aroma are paramount for consumers, while nutritional value receives comparatively lower importance. Statistically significant variations in rankings underscore distinct priorities among consumers, with differences observed across socioeconomic groups and in regard to gender. University graduates and individuals with higher incomes prioritize freshness and healthiness, indicating the impact of education and income on preferences. Notably, even among low-income consumers, price ranks as the least important characteristic. The study highlights the complex interactions between consumer preferences and socio-demographic factors, emphasizing the need for nuanced marketing strategies. The results challenge the common belief that higher prices imply higher quality, emphasizing the significance of health-related attributes in shaping consumer choices.

Keywords: Food quality characteristics, consumer priorities, food producers, food retailers, geographical location, external food characteristics, natural food characteristics

JEL Classification: N34, P36, P46

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1. Introduction

Consumers' biological food requirements remain uniform, but decision-making processes diverge during food shopping. These decisions are contingent on consumers' personal priorities regarding food characteristics, eating habits, and local food culture. The significance and priority assigned to specific food attributes by consumers also offer insight into their perspectives on food quality. Notably, in Turkey, 89.3% of consumers consider food quality as one of the crucial factors influencing their food choices (Ministry of Trade, 2018).

Food quality is the most important food attribute motivating consumers during shopping. For 90% of consumers, the most important characteristic is food quality, a significant composite characteristic for consumers (Ministry of Trade, 2018). This includes external factors, such as appearance (size, shape, color, gloss, and consistency), texture, and flavor or factors such as federal grade standards (e.g., of eggs), as well as natural factors (chemical, physical, microbial). In many countries, food quality is regulated by a government agency. For example, food quality in the United States is regulated and monitored by the Food Safety Act 1990. Generally, quality evaluation of food consists of two stages: The first one precedes the purchasing act, and the second one is related to what happens after the purchasing act when food is being consumed. Regarding the first stage, at the point-of-purchase, consumers use both explicit cues (e.g., color, price, and claims) and subtle cues communicated through packaging design, i.e., graphics, material, and color (Magnier, Schoormans, & Mugge, 2016). According to the 1970 Yearbook of Agriculture, quality is the measure or expression of goodness (Ferree, 1973). Food quality is a central issue in today's food economics, and in the last few decades consumers' concerns for healthier lifestyles, environment protection and conservation are driving forces reshaping consumers' food buying intentions and perspectives on food quality (Grunert, 2005).

The degree of importance consumers attach to food properties also serves as an indicator of their level of awareness. Understanding what consumers consider significant when purchasing food is crucial for those aiming to enhance consumer awareness, including public health officials and retail food sellers. Consumers make purchases based on the belief that such choices will fulfill one's recognized needs (Agyekum, Haifeng, & Agyeiwaa, 2015). Selecting a product to meet specific needs relies on consumers' perception that its food quality can satisfy such needs. Consumers' initial impression of a food item is shaped by its fundamental sensory attributes, such as appearance, texture, and flavor. While many business managers tend to focus on technical aspects of product production, most customers assess a product based on its overall quality and the level of satisfaction it provides (Agyekum, Haifeng, & Agyeiwaa, 2015). By understanding consumers' opinions on food characteristics and their prioritization of food attributes, food retailers can more effectively manage the process of food production and sales in a rational manner.

When providing food products at the point of sale, both producers and distributors need to consider the factors that define a modern consumer who exhibits heightened interest and concern regarding several aspects. These include food safety, a growing awareness of the connection between food, nutrition, and health, general well-being, an increasing demand for easily disposable and environmentally friendly food packaging, as well as convenient food options of products easy to prepare in line with changing lifestyles. It is evident that consumers' varying degrees of preference for certain food product features serve as the basis for identifying different consumer groups (Baryłko-Pikielna, 2003).

Food markets serve as meeting points for consumers and food producers, providing trading organizations with direct contact opportunities with their customers. The interactions between traders and customers play a significant role in shaping buying patterns and influencing customer satisfaction with their purchases. Sellers have long recognized the importance of establishing contact with customers, particularly when reinforcing their ability to learn about product features that resonate with their specific desires, as this often determines success in the market. However, the role of vendors in the success of trading enterprises is diminishing due to the increasing influence of "virtual instruments" or packaging (Nowicki & Sikora, 2012). The food market has witnessed a deepening fragmentation of consumer needs, accompanied by a clear process of diversification in terms of consumers' expectations from specific foods. The distribution system is rapidly adapting to respond to consumer needs and desires, leading producers to adjust their supply accordingly. Additionally, aggressive, and product-specific advertising is being employed to persuade consumers to choose specific products (Gutkowska & Ozimek, 2005). Today's consumers have a range of options when making purchases through different types of trading organizations, each offering diverse assortments, product prices, additional services, while enjoying varying levels of popularity among consumers (Gutkowska & Ozimek, 2005).

Turkey exhibits diverse cuisines and eating habits across different geographical regions (Güler, 2010), leading to variations in consumer food choices during shopping. The importance consumers place on different food characteristics when purchasing these diverse foods reflects one's sensitivity concerning nutritional awareness. In recent years, there has been an increasing tendency to prioritize food choices based on healthiness and nutritional value. Thus, it becomes crucial to examine the role of nutritional value and health benefits of food during the shopping process. Considering consumers' preference priorities for foods is a vital factor that influences their ability to meet their nutritional needs and the overall profitability of all participants in the supply chain. Food characteristics that consumers consider are significantly influenced by local food culture, geographic location, and eating habits. In the Black Sea region, the basic cuisine consists of anchovy, hazelnut, tea, corn flour, and commonly consumed vegetable dishes. Frying and roasting methods are prevalent

in the Black Sea cuisine. The local cuisine also features black cabbage as the main crop, alongside vegetables like chard and nettle. Milk and dairy product consumption is relatively low in this region. In Eastern Anatolia, meat and dairy products are staple foods, while vegetable and fruit production are limited due to geographical constraints, which means they are less consumed. Grain products such as bulgur (cracked wheat) and pastries are popular, and dry legumes are frequently included in meals. The region is known for its use of dried vegetables and fruits, tarhana (a yogurt, wheat flour, and tomato soup with herbs), jams, pickles, and pickled vegetables. Herb cheese is a famous food in the Van area. In South-Eastern Anatolia, meat, particularly mutton and lamb, is the main source of food, and frying and roasting are common cooking methods. Raw meatballs, pilafs, and sweet desserts prevail, and breakfasts often include pistachios and cream. In central Anatolia, flour-based foods and meats are prominent, with reduced consumption of vegetables and fruits in winter. Delicatessen products are popular in the Kayseri region, and cereal products such as cut-in soup, noodles, pasta, and pastries are commonly consumed. Casserole-style cooking of vegetables is popular during the summer months. The Aegean region is renowned for its healthy and light dishes, with a focus on olive and olive oil-based dishes, along with increased consumption of vegetables and fish. The Mediterranean region shares similarities with the Aegean region but also has its own distinct features. In Adana and surrounding areas, the use of tail fat in meat dishes is common, and pickles, turnip juice, local mezes (such as tahini and dried beans), and spices are prevalent. Frying, roasting, boiling, and steaming are commonly employed cooking methods. The Marmara region, similar to the Aegean region, features olive oil-based meals. Istanbul, located in the Marmara region, serves as a melting pot, bringing together cuisines from various regions due to its population of 15 million composed of people from different parts of Turkey.

Contextual effects and expectations are only two examples of the many factors that can affect judgments of food and food quality. Numerous others fall into either the category of physiological influences (e.g. hunger and satiety, sensory adaptation level) or cultural and ethnic influences (Cardello A. V., 1995a). Food quality is classified based commercial, price and nutritional quality, referring to for example cleanliness, firmness, color, size and shape, freshness, texture, aroma (commercial quality) and to essential nutrients (carbohydrates, amino and fatty acids) and biologically active compounds (vitamins, dietary fiber, flavonoids, carotenoids, phytosterols, phenolic acids and glycosylates) regarded as aspects for nutritional quality (Edwards◻ Jones, et al., 2008). Apart from nutritional values, organoleptic aspects (such as taste, color, fragrance) also determine the quality of a food product (Noordhuizen & Metz, 2005). In this study, 16 food quality characteristics are first considered under two groups as characteristics that belong to the food itself and characteristics that people add to the food. When considering the characteristics of food, several factors come

into play. Healthiness refers to foods that are low in fat, sugar, salt, and additives and high in fiber. The concept of "healthiness" is relative to conventional versions of the same food, such as low-fat milk compared to whole-fat milk, and such assessment depends on the overall diet (Darrall, 1992). Freshness relates to the recent picking or harvesting of vegetables and fruits, the recent slaughtering of meat animals, and the recent catch of fish. Color refers to the natural hue, lightness, and saturation of food items. Odor is the property of certain substances, in very small concentrations, to stimulate chemical sense receptors (Encyclopedia Britannica, 2020) of food. *Shelf life* is the period of time during which a material or food may be stored and remain suitable for use (Merriam-Webster, 2020). Production technique refers to the mode of production, whether it is being conventional, organic, or follows Good Agricultural Practices (GAP). Locality indicates the place where the food is produced, such as a city, region, or rural area close to consumer's residence. Aroma represents the attribute of a substance that can be recognized through the senses of smell, taste, and touch primarily perceived within the mouth. *Aroma* is the attribute of a substance recognized through the senses of smell and taste, as well as touch when perceived within the mouth. Tasting occurs chiefly on the tongue through the taste bud, which are stimulated by five fundamental taste sensations, sweet, salty, sour, bitter, and umami (Encyclopedia Britannica, 2020). *Nutritive value* encompasses the contents of food and the impact of its constituents on the body; nutrients include carbohydrates, fats, proteins, minerals, additives, enzymes, vitamins, sugar, cholesterol, and salt. Generally, food labels provide consumers with information on the nutritional value of a product.

Consumers also attach significant importance to external attributes of food quality. Price represents the monetary amount required to acquire a specific product. Packaging involves the processing of food for future sale. The selling place refers to the location where food is sold. A brand refers to a specific type of product or food that is associated with a particular company and carries its own name. A label is a small piece of paper or material that provides information about the item it is attached to. Hygiene encompasses practices and processes aimed at maintaining cleanliness, particularly in order to prevent disease. Eating habits encompass the reasons, choices, and methods by which individuals consume food, including the types of food they eat, their dining companions, as well as how they acquire, store, use, and dispose of food (Encyclopedia.com, 2020).

Examining the geographical influence on consumer priorities related to food quality characteristics is crucial for several reasons. Different regions often have distinct culinary traditions, cultural practices, and environmental factors that shape consumers' preferences. By understanding how geographical location influences consumer priorities in food quality characteristics, food producers and retailers can tailor their products to better meet the specific preferences and demands of different regions.

Geographical variations in consumer preferences enable effective market segmentation. Analyzing how consumer priorities differ across different geographical regions allows businesses to develop region-specific marketing strategies, product formulations, and branding approaches to better resonate with local consumers' tastes. Geographical influence can provide valuable insights for product development. By understanding which food quality characteristics are of higher importance in specific regions, food producers can adjust their product formulations, packaging, labeling, and sourcing strategies to align with the preferences of target markets. Recognizing and leveraging geographical variations in consumer priorities can provide a competitive advantage. Businesses that understand and cater to the unique preferences of different regions can differentiate themselves from competitors, build stronger customer loyalty, and capture larger market shares in specific geographical areas. Geographical influence on consumer priorities concerning food quality characteristics may also shed light on sustainability concerns and environmental impacts. By examining regional preferences, businesses can identify opportunities for promoting sustainable practices, support local agriculture, and reduce the environmental footprint associated with food production, distribution, and consumption.

## 2. Theoretical Background and Aim of the Study

Consumer priorities for food quality characteristics are influenced by various theoretical frameworks and factors. The hedonic theory suggests that consumers evaluate and prioritize food quality based on the sensory and experiential aspects of a product. Factors such as taste, texture, aroma, and appearance play a significant role in determining consumer preferences. Consumers tend to prioritize sensory attributes that provide pleasure and satisfaction while consuming food (Cardello, 1994).

According to the expectancy-disconfirmation theory, consumers form expectations about a product's quality based on previous experiences, information, and advertising. When their actual experience matches or exceeds their expectations, they tend to be satisfied. If there is a disconfirmation, whether positive or negative, between expectations and experience, this may influence consumer priorities concerning food quality characteristics (Oliver, 2014). Consumer priorities for food quality also depend on one's health and nutrition concerns. This can be influenced by various factors, including nutritional knowledge, dietary preferences, cultural beliefs, and personal health goals. Consumers may prioritize food products that offer higher nutritional value, such as essential nutrients and biologically active compounds, so as to meet their specific health and dietary requirements (Grunert, Hieke, & Wills, 2012). Consumers are concerned about the safety and potential risks associated with food consumption (Verbeke, 2006). Factors such as cleanliness, freshness, and hygiene practices in food production and handling can significantly influence consumer priorities. Food safety certifications, labeling, and transparent information about ingre-

dients and production methods can also impact consumer perceptions and priorities in regard to food quality characteristics. Consumer priorities related to food quality can be influenced by socioeconomic factors such as income, educational level, and cultural background (Wansink, 2004). Affordability and price often play a role in consumer decision-making, especially for consumers with limited financial resources (Padel & Foster, 2005). Different socioeconomic groups may prioritize different aspects of food quality based on their specific needs and preferences.

It's important to note that consumer priorities when considering food quality characteristics can vary across individuals and cultures. Additionally, contextual factors such as product availability, marketing strategies, and social influences can also shape consumer preferences and priorities.

The objective of this study is to explore the factors and priorities of consumers across various geographical areas in Turkey concerning attributes related to food quality. These attributes encompass natural aspects such as healthiness, aroma, food value, production technique, color/shape, odor, as well as external factors such as freshness, hygiene, shelf life, eating habits, locality, labeling, price, selling place, packaging, and brand (Figure 1).
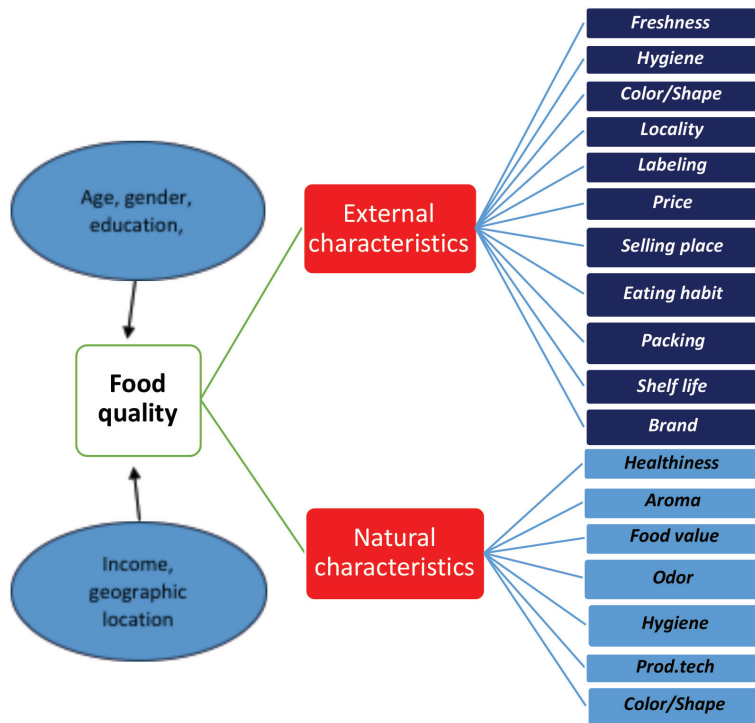
Figure 1: External and natural food characteristics

Studying the geographical influence on consumer priorities regarding food quality characteristics allows businesses to effectively target specific markets, tailor their products, and gain a competitive edge by understanding and meeting the preferences of different regions. It also provides insights into sustainability and environmental considerations related to food production and consumption.

3. Literature Review and Research Hypotheses

No study has been found in Turkey and across the world that takes into account how consumers prioritize food quality characteristics; this absence highlights a potential gap in knowledge that may hinder informed decision-making by businesses, policy-makers, and other stakeholders, namely, food producers and food industry retailers. Addressing this gap through relevant research can lead to improved market responsiveness, consumer satisfaction, and public health outcomes.

A study carried out among Belgian and Romanian consumers identifies the importance that consumers attach to selected quality, health, and environment selected cues of food products purchased. Their findings suggest that investigated consumers most frequently assess food quality based on freshness, taste, and appearance (Petrescu, Vermeir, & Petrescu-Mag, 2020). Another study concluded that food quality cues as well as nutritional attributes affected consumer food choices during the COVID-19 pandemic regardless of gender (Anis, Rahman, & Khalid, 2022). Gültekin and Veuphuteh found that the moderating role of health consciousness is significant concerning food quality-purchase intention and price sensitivity-purchase intention relationships in both samples (Gültekin & Veuphuteh, 2023). In their study, Lambotte, Cara and Bellasen aimed to analyze the behavior of French consumers with respect to food products under various quality labels (organic, label rouge, and geographical indications). They found that product attributes are more often related to regular organic behavior than household characteristics. In particular, product availability and product family (vegetables, eggs, milk, etc.) play a key role whereas low-price organic products are not associated with more regular consumption (Lambotte, Cara, & Bellassen, 2020). A study by Guzek, Glabska, Sajdakowska and Gutkowska obtained results suggesting that in the case of application of novel packaging, a higher level of knowledge may be a reason for a consumer's rejection of the products contained, but the appearance and taste of products may contribute towards higher acceptance of novel packaging (Guzek, Głąbska, Sajdakowska, & Gutkowska, 2020). Findings of Zhang and Jakku suggest that consumers value the importance of various food attributes in a hierarchical order, and there is significant heterogeneity in consumers' food preferences (Zhang & Jakku, 2020). Aşkan, Topcu and Şahin reported that physiological needs of the consumers residing in region I were based on the physiological and physical quality of the water they prefered to consume; consumers in region II relied on the chemical quality of tap water, and consumers in region III

focused on cost advantages of tap water depending on its chemical quality (Aşkan, Topcu, & Şahin, 2021). The results of a study by Liguori, Sortino, Gianguzzi, Inglese and Farina confirmed that mango ripening leads to increased expression of quality and sensory attributes, as well as aromas, tropical flavor, and taste (Liguori, Sortino, Gianguzzi, Inglese, & Farina, 2018). Wang, Han, Jiang and Wu found that fresh food purchasing online is quite different from non-food products because of its unique features, i.e., perishability, low cost and frequent purchases, low value-volume ratio, and high relevance to safety and health (Wang, Han, Jiang, & Wu, 2022). Zaibet, Bachta, Lajimi and Abbassi found a strong concern about hygiene among other quality attributes and strong awareness about quality and quality assurance schemes in general. Consumers are also motivated by habits of consuming home-made products for hygiene and taste reasons (Zaibet, Bachta, Lajimi, & Abbassi, 2004). The results of a study by Lestari, Pradani and Digdowiseiso showed that price perception had a positive and significant effect on customer loyalty, while both food quality and menu variations had an insignificant effect on customers' loyalty. In addition, food quality had a positive and significant effect on ordering decisions. Meanwhile, menu variations produced an insignificant effect on ordering decisions. Similarly, menu variations showed an insignificant effect on ordering decisions. Price perception had a positive and significant effect on customer loyalty, while both food quality and menu variations had an insignificant effect on customer loyalty (Lestari, Pradani, & Digdowiseiso, 2022). A study conducted by Oakes & Slotterback revealed that gender, age, and dieting status are significant predictors of the primary food characteristic that individuals consider when evaluating the healthiness of foods (Oakes & Slotterback, 2002). Smed and Hansen conducted a separate study which found that individuals with higher levels of education exhibit lower preferences for health in comparison to those with lower levels of education. The study suggested that variations in taste preferences, rather than differences in health preferences, account for the healthier dietary choices observed among individuals with higher education levels (Smed & Hansen, 2016). In a study by Grunert, a food quality model was developed, and the formation of quality expectations were analyzed (Grunert K. G., 2002). Some studies have shown that consumers perceive the price as a quality cue: the higher the price, the higher the subjective quality perception (Rao, 2005; Jo & Sarigollu, 2007).

Within the aims of the study, premise hypotheses are as follows:

Hypothesis 1: Price is of higher priority among the food quality characteristics Turkish consumers consider.

Hypothesis 2: Healthiness is of a higher priority among the food quality characteristic Turkish consumers consider.

Hypothesis 3: Consumers of certain characteristics tend to prefer food based on its natural features.

Hypothesis 4: Consumers of certain characteristics tend to prefer food based on its external features.

Hypothesis 5: Socioeconomic factors influence consumers' prioritization of food quality characteristics, i.e., different socioeconomic groups display different rankings.

3.1 Sampling and Data

To determine the sample size for this study, one representative city was chosen from each of the seven geographical regions in Turkey. The number of households was utilized to calculate the appropriate sample size using the formula below (Miran, 2021).

$$n = \frac{Np(1-p)}{(N-1)\sigma_{\hat{p}_x}^2 + p(1-p)}$$

n : Sample size

N: 7,313,860 (Total number of households in the selected cities)

$\sigma_{\hat{p}_x}^2$: 0.0006507601 (Variance of proportion with a 95% confidence level and a 5% margin of error)

p=0.50

To obtain the maximum sample size, we assigned a value of 0.50 for p (probability) and q (complement of p). With a 95% confidence level and a 5% margin of error, the calculated sample size is 1086. The sample size was then distributed among various age groups, genders, income levels, and cities according to predetermined quotas, ensuring proportional representation based on the groups' respective shares in the total population. The reason for choosing quota sampling is that it offers several advantages for our study. By setting quotas for various demographic factors, such as age, gender, income levels, and cities, researchers can ensure that the sample accurately represents the population. This helps in generalizing the findings of the study for the larger population and allows researchers to quickly and conveniently select participants based on specific criteria without the need for a complete sampling frame. Quota sampling allows for the inclusion of participants from different demographic groups, ensuring sample diversity. This diversity can help capture a range of perspectives and experiences related to food choices and preferences across different regions of Turkey. It provides a broader understanding of consumer behavior and priorities. Quota sampling also facilitates the comparison of results across different regions and demographic groups. By setting consistent quotas across regions and demographic categories, researchers can analyze and compare findings to identify patterns and variations in consumers' priorities and preferences related to food quality characteristics. In line with the corresponding demographic quota, consumers who engage in food shopping at a well-established retail chain, which operates under

different names across all geographic regions of Turkey catering to diverse income levels, have willingly taken part in the survey.

Table 1 presents the selected provinces according to regions, along with the number of households and survey counts.

Table 1: Number of interwiews by regions

Geographical Region	Representative City	Population	Number of Households	%	Number of interviews
Aegean	İzmir	4,061,078	1,015,270	13.9	151
Marmara	İstanbul	14,160,471	3,540,118	48.4	525
Central Anatolia	Ankara	5,045,087	1,261,272	17.2	187
Mediterranean	Antalya	2,158,269	539,567	7.4	80
South-Eastern	Şanlıurfa	1,801,984	450,496	6.2	67
Doğu Anadolu	Erzurum	766,733	191,683	2.6	29
Black Sea	Samsun	1,261,814	315,454	4.3	47
Total		**29,255,436**	**7,313,860**	**100.0**	**1086**

3.2 Method

Among the food quality characteristics examined, a total of 16 factors were identified as influential factors in food shopping for consumers in Turkey. These factors include food value, eating habits, hygiene, odor, taste/flavor, healthiness, freshness, shelf life, color, locality, label, production technique, selling place, packaging, price, and brand (Grebitus, 2008).

In order to assess the food characteristics, consumers were requested to provide ratings using a Likert scale, which is an ordinal measurement method used to gauge attitudes by having individuals respond to a set of statements indicating their level of agreement or importance. Within this study, participants were presented with a series of statements, and for each statement, they were asked to indicate their level of agreement or disagreement using a five-point scale (Brace, 2008). The scale employed in this study ranged from 1 to 5, with 1 indicating unimportance, 2 representing little importance, 3 denoting moderate importance, 4 indicating importance, and 5 signifying very importance.

The data representing priorities, obtained from the scores assigned by consumers on the Likert scale to food quality characteristics, were utilized for the following purposes: 1) Hierarchical cluster analysis was conducted to determine the cluster membership of the food characteristics based on the scores. 2) Two-step Euclidean cluster analysis was employed to predict the importance of the food characteristics and identify customer segments. In the final phase of the analysis, the Friedman test was

employed to assess differences among the priority ratings assigned to the food quality characteristics. This test facilitated the identification of homogenous subset groups. To conduct the Friedman test, the original numerical scores were first converted to ranks and then analyzed. This test was chosen because the scores given to the food characteristics were derived from repeated measures taken from related samples. The Friedman test allowed for the examination of whether the priorities of the food characteristics were equal or not, based on their ranking. Multiple comparisons were made to form homogenous subsets of the food characteristics with respect to their ranks. Kendall's W coefficient of concordance was also used to measure agreement among consumers regarding the ranking of the food characteristics (Miran, 2021).

Both the Friedman test and Kendall's W coefficient of concordance were applied to analyze the socio-economic features of the consumers. Kendall's coefficient of concordance, proposed by Maurice G. Kendall and Bernard Babington Smith, is a measure of agreement among several quantitative or semi-quantitative variables used to assess a set of objects of interest. In the context of social sciences, these variables often represent judges assessing different subjects or situations. Kendall's coefficient of concordance and Milton Friedman's two-way analysis of variance without replication by ranks share a close relationship. They address hypotheses concerning the same data table and utilize the same $\chi 2$ statistic for testing, differing only in the formulation of their respective null hypotheses (Legendre, 2010).

We also focus solely on the natural and external characteristics of food in order to achieve more concise results using an approach of only two directions. In other words, we aimed to understand which consumer characteristics influenced consumers' preference for food based on its external features and which characteristics influenced consumers' preference for food based on its natural features. To achieve this, separate logit models (Miran, 2023; Greene, 2018) were used to analyze and determine which consumer characteristics played a role in their preference for food based on their external and natural attributes.

3.3 Descriptive Statistics of the Sample

Data for this study were obtained from seven distinct geographical regions in Turkey. The average age of consumers was approximately 38 years, and the average household size slightly exceeded 3 individuals (Table 2).

Table 2: Consumers' descriptive statistics

Variable	Mean	Median	Minimum	Maximum
Age	37.93	35	18	80
Household size	3.34	3	1	11

Of the consumers', 47.9% identified as male and 52.1% as female. In terms of income level, 37.3% were classified as low income, 27.6% as middle income, and 35.1% as high income. Additionally, 65.8% of consumers held a university degree (Table 3).

Table 3: Descriptive statistics of consumers' categorical properties

Conusmer Properties		Frequency	%
Gender	Male	520	47.9
	Female	566	52.1
	Total	1086	100.0
Education	Mid-school and lower	121	11.1
	High school	250	23.0
	University and higher	715	65.8
	Total	1086	100.0
Income	Low class (-1999 TL)	404	37.3
	Middle class (2000-4999 TL)	299	27.6
	High class (5000 TL +)	379	35.1
	Total	1082	100.0
City	Ankara	187	17.2
	Antalya	80	7.4
	Erzurum	29	2.7
	İstanbul	525	48.3
	İzmir	151	13.9
	Samsun	47	4.3
	Sanliurfa	67	6.2
	Total	1086	100.0
Age	Age <=25	268	24.7
	25<Age<=50	578	53.2
	Age >50	240	22.1
	Total	1086	100.0

4. Empirical Results

Cluster analysis was conducted to group food quality characteristics into homogeneous categories. The two-step Euclidean cluster analysis resulted in the formation of five distinct homogeneous clusters, which are presented in Table 4.

Table 4: Two-step Euclidean cluster analysis results for food characteristics

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Hygiene, healthiness, freshness, color, odor, shelf life, aroma production technique, locality, eating habits, nutritive value	Price	Packing	Selling place, brand	Labelling

As observed, cluster 1 primarily consists of the intrinsic characteristics of food, while the externally added characteristics are distributed across clusters 2 to 5. The two-step Euclidean cluster analysis yielded predicted importance scores for the food characteristics, and the pattern of relative importance is outlined in Table 5. Findings highlight the paramount importance of food being healthy, followed closely by aroma, both of which scored above 0.90 out of 1.00. Notably, nutritive value ranked sixth with an importance score that was less than half of the score for food healthiness. This indicates a relative lack of consumer concern for the nutritive aspect of food, as it even falls behind the importance attributed to the odor of food.

Table 5: Scores of importance by food characteristics

Food Characteristics	Level of Importance
Healthiness	1.0000
Aroma	0.9446
Freshness	0.9053
Eating habit	0.5618
Odor	0.5238
Nutritive value	0.4397
Hygiene	0.4232
Color	0.3556
Locality	0.3442
Shelf life	0.3168

4.1 Priorities of the Food Quality Characteristics

To establish statistically significant priority values for food characteristics, the Friedman test was conducted. The mean ranks of food characteristics following the Friedman test are presented in Table 6. Findings indicate that consumers throughout Turkey consistently prioritize the healthiness and freshness of foods when making their shopping choices. Conversely, price, packaging, and brand are at the lowest ranking position, while production technique falls within the middle rank range. The results of the Friedman test confirm the statistical significance of the ranks assigned to food properties. It is evident that consumers assign different levels of priority to each food quality characteristic. Additionally, the Kendal's W coefficient is calculated at 0.172, indicating a moderate level of agreement among consumers regarding the ranking of food characteristics. According to Kendall's interpretation guidelines, this level of concordance exceeds a small effect and falls within the moderate effect range, suggesting a considerable level of agreement among consumers when determining the priority levels of food characteristics.

Table 6: Descriptive statistics of food quality characteristics and their priority ranking*

Food Characteristics	Mean Rank	Minimum	Maximum	Priority as rank mean
Healthiness	1	1	1	1
Freshness	1	1	1	1
Aroma	1.07	1	2	2
Hygiene	1.14	1	2	3
Food value	2	1	4	4
Odor	2.07	1	4	5
Shelf life	2.13	1	4	6
Eating habit	3	1	6	7
Prod. technique	3.27	1	7	8
Color/Shape	3.33	1	6	9
Locality	4.2	1	7	10
Labeling	4.33	1	7	11
Price	5.75	1	8	12
Selling place	6	3	9	13
Packaging	6.8	4	10	14
Brand	7.27	5	11	15

* Friedman's test statistic=2793 (p=0.000), Kendals W=0.172

Table 7 displays the mean, minimum, and maximum priorities of the food quality characteristics based on consumer socio-economic characteristics, as determined

Table 7: Descriptive statistics of food quality characteristics and their priority ranking by consumer groups

Food Characteristics	EDUCATION			GENDER			INCOME			CITY			AGE		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Packing	7.00	6.00	8.00	7.00	5.00	9.00	6.29	4.00	8.00	7.67	6.00	10.00	8.3	7.0	10.0
Food value	1.67	1.00	3.00	3.00	2.00	4.00	1.57	1.00	3.00	2.67	2.00	4.00	2.7	2.0	3.0
Eating habit	2.67	1.00	4.00	3.50	2.00	5.00	2.29	1.00	3.00	4.67	4.00	6.00	4.0	3.0	5.0
Labeling	4.67	3.00	6.00	5.50	4.00	7.00	3.43	1.00	5.00	5.33	4.00	7.00	6.0	5.0	7.0
Price	6.67	6.00	8.00	6.50	5.00	8.00	5.29	2.00	7.00	5.50	1.00	8.00	7.3	7.0	8.0
Hygiene	1.33	1.00	2.00	1.50	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.3	1.0	2.0
Odor	1.67	1.00	3.00	2.50	2.00	3.00	1.57	1.00	3.00	3.33	2.00	4.00	3.3	2.0	4.0
Aroma	1.33	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.0	1.0
Brand	7.67	7.00	8.00	7.00	6.00	8.00	6.86	5.00	9.00	8.00	6.00	11.00	8.0	7.0	9.0
Shelf life	2.00	1.00	3.00	3.00	2.00	4.00	1.57	1.00	3.00	3.00	3.00	3.00	3.3	2.0	4.0
Color	3.67	2.00	5.00	4.50	3.00	6.00	2.14	1.00	4.00	5.00	5.00	5.00	4.7	3.0	6.0
Heathy	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.0	1.0
Selling place	5.67	4.00	7.00	6.50	5.00	8.00	5.57	3.00	7.00	7.00	6.00	9.00	7.0	6.0	8.0
Freshness	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0	1.0	1.0
Prod.tech.	3.33	2.00	5.00	5.00	4.00	6.00	2.00	1.00	3.00	5.00	4.00	7.00	4.7	3.0	6.0
Locality	3.33	2.00	5.00	5.50	4.00	7.00	3.57	1.00	5.00	5.67	5.00	7.00	5.7	4.0	7.0

through Friedman tests. Priority statistics differs across consumer properties, ranging from a minimum of 1 for freshness and healthiness to a maximum of 2 to 8 for price, and 4 to 10 for packing.

Table 8 presents the results of Friedman tests and Kendall's W statistics for each food characteristic, categorized by the socio-economic properties of consumers. Based on the Friedman test results, it is evident that the food characteristics are ranked differently among consumers of different socio-economic groups. This indicates that consumers assign varying levels of priority to food quality characteristics based on their socio-economic characteristics. However, the level of agreement among differ-ent socio-economic groups in ranking food characteristics is not very high. On the contrary, there is a moderate level of agreement, ranging from 12% to 23% within a particular group. This suggests that consumers prioritize food characteristics differ-ently, but with a moderate level of consensus.

Table 8: Friedman and Kendal's W test results by consumer socio-economic groups

Consumer properties	Friedman (Chi Square)	Kendal's W	p value
Male	1127.6	0.157	0.000
Female	1599.8	0.189	0.000
Up to Mid-school	228.0	0.126	0.000
High school	576.0	0.154	0.000
University and upper	2041.7	0.191	0.000
Low income	1152.8	0.154	0.000
Middle income	1109.7	0.185	0.000
High income	474.4	0.212	0.000
Antalya	508.4	0.181	0.000
Erzurum	208.0	0.173	0.000
İstanbul	73.7	0.169	0.000
İzmir	1346.1	0.171	0.000
Samsun	475.0	0.213	0.000
Ankara	128.7	0.183	0.000
Urfa	139.6	0.139	0.000
Age <=25	750.8	0.187	0.000
25<Age<=50	1524.8	0.176	0.000
Age >50	606.5	0.170	0.000

For the purpose of easier interpretation, ranks assigned by consumers to food quality characteristics have been grouped into six homogeneous categories: rank 1,

rank 2, rank 3, rank 4, rank 5, and rank 6 (including rank 6 to rank 16). The food quality characteristics that are ranked in the same order of priority are indicated in the same column with the (•) symbol in the following tables. Across all consumer groups, it is evident that freshness and healthiness of food are given the highest priority by all consumers Table 9. It can be observed that both females and males prioritize aroma, freshness, and healthiness characteristics, with males considering hygiene as the second priority and females assigning it as the first priority. Among the 16 food quality characteristics, hygiene and odor consistently hold the second or third place priority rank across all socio-economic groups. While consumers with a university education prioritize only freshness and healthiness, those with lower educational levels include characteristics such as aroma, hygiene, odor, and food value in their first priority category. All income categories prioritize freshness, healthiness, and aroma as the most important characteristics. It is evident that price is not considered the top priority by Turkish consumers. Price becomes relevant only after consumers are satisfied with the aroma, freshness, and healthiness of a food item.

Table 9: General ranks of food quality characteristics in Turkey

Food Characteristics	Priority#					
	1	*2*	*3*	*4*	*5*	*6*
Healthiness	•					
Freshness	•					
Aroma	•					
Hygiene		•				
Food value			•			
Odor				•		
Shelf life				•		
Eating habits					•	
Production technique						•
Color/Shape						•
Locality						•
Labeling						•
Price						•
Selling place						•
Packing						•
Brand						•

In summary, healthiness, freshness, and aroma emerge as the most crucial food quality characteristics in Turkey. They are followed by hygiene and nutritional value in the second and third places, respectively, while odor and shelf life occupy the fourth place. The remaining characteristics, including price, are ranked sixth or lower. This suggests that the typical Turkish consumer first focuses on intrinsic food-related characteristics and, once satisfied, takes price into consideration.

Females assign secondary importance to nutritive value, whereas males consider it to be of third importance (Table 10). Eating habits, production technique, locality, and labeling are perceived as higher priorities by females compared to males. Females prioritize the label more than males do. Additionally, females show greater concern about food prices than males. Selling establishment is ranked at the bottom of the priority list for both genders. Brand is also considered a lower priority by both females and males.

Table 10: Priorities of Food quality characteristics by gender in Turkey

Food Characteristics	Gender											
	Female						Male					
	Priority#						Priority#					
	1	2	3	4	5	6	1	2	3	4	5	6
Healthiness	•						•					
Freshness	•						•					
Aroma	•						•					
Hygiene	•							•				
Food value		•								•		
Odor		•							•			
Shelf life		•								•		
Eating habit		•									•	
Prod.tech.				•								•
Color/Shape			•									•
Locality				•								•
Labeling				•								•
Price					•							•
Selling place					•							•
Packing					•							•
Brand						•						•

Consumers with education levels up to mid-school and high school graduation prioritize six food characteristics, namely healthiness, freshness, aroma, hygiene, food value, and odor, as their top priorities. On the other hand, university graduates rank healthiness and freshness as their first priority, followed by aroma and hygiene in second place, and food value and odor in the third. While consumers with up to mid-school and high school education rank price at the fifth priority place, those with a high school education or higher rank price as the least important characteristic. Regardless of educational level, brand consistently ranks as the least important food characteristic among all consumers (Table 11).

Table 11: Ranking of food quality characteristics by consumers' education level in Turkey

Food Characteristics	Education																	
	Up to Mid-school						High school						University and upper					
	Priority#						Priority#						Priority#					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Healthiness	•						•						•					
Freshness	•						•						•					
Aroma	•						•							•				
Hygiene	•						•							•				
Food value	•						•								•			
Odor	•						•								•			
Shelf life		•										•			•			
Eating habit												•			•			
Prod.tech.			•					•									•	
Color/Shape		•								•						•		
Locality		•						•									•	
Labeling			•						•								•	
Price				•								•						•
Selling place			•									•						•
Packing				•								•						•
Brand						•						•						•

Irrespective of their income level, consumers consistently prioritize healthiness, freshness, aroma, and hygiene as the top four food characteristics. Likewise, across all income levels, price, selling place, packaging, and brand are consistently ranked in the last four positions. It is worth mentioning that even among low-income consumers, price is ranked as the least important of food characteristics (Table 12).

Table 12: Ranking of Food quality characteristics by consumers' income level in Turkey

Food Characteristics	Income																	
	Low income						Middle income						High income					
	Priority#						Priority#						Priority#					
	1	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*	*4*	*5*	*6*
Healthiness	•						•						•					
Freshness	•						•						•					
Aroma	•						•						•					
Hygiene	•						•						•					
Food value				•				•						•				
Odor		•								•						•		
Shelf life			•						•						•			
Eating habit						•				•						•		
Prod.tech.						•				•						•		
Color/Shape					•						•						•	
Locality						•					•						•	
Labeling						•					•					•		
Price						•						•						•
Selling place						•						•						•
Packing						•						•						•
Brand						•						•						•

The order of ranking for nutritional properties among different age groups closely resembles that of income groups (Table 13).

Table 13: Ranking of Food quality characteristics in Turkey by consumers' age group

Food Characteristics	Age																	
	<=25						25<Age<=50						Age >50					
	Priority#						Priority#						Priority#					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Healthiness	•						•						•					
Freshness	•						•						•					
Aroma	•						•						•					
Hygiene	•							•					•					
Food value			•						•					•				
Odor		•								•						•		
Shelf life		•								•						•		
Eating habit				•							•				•			
Prod.tech.				•								•			•			
Color/Shape			•									•					•	
Locality						•						•			•			
Labeling						•						•					•	
Price						•						•						•
Selling place						•						•						•
Packing						•						•						•
Brand						•						•						•

Consumers in Erzurum, Istanbul, Ankara, and Urfa consistently prioritize production technique as a significant food quality characteristic (Table 14).

Table 14: Estimated results of logit models for natural and external food quality characteristics

Cities representing geographical regions of Turkey

Food Characteristics	Antalya Priority#						Erzurum Priority#						İstanbul Priority#						İzmir Priority#						Samsun Priority#						Ankara Priority#						Şanlıurfa Priority#					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Healthiness	•						•						•						•						•						•						•					
Freshness	•						•						•						•						•						•						•					
Aroma	•						•						•						•						•						•						•					
Hygiene	•						•						•						•						•						•						•					
Food value			•				•						•							•						•					•						•					
Odor	•						•						•								•					•					•						•					
Shelf life			•				•						•								•				•						•						•					
Eating habit			•					•						•							•					•						•					•					
Prod.tech.			•				•						•								•					•					•							•				
Color/Shape			•				•						•									•						•			•						•					
Locality				•									•										•						•				•					•				
Labeling				•						•			•									•						•					•							•		
Price						•					•			•										•						•					•						•
Selling place						•					•				•									•						•					•					•		
Packing						•						•				•								•						•				•							•	
Brand						•						•					•							•						•						•					•

4.2 Natural and External Food Quality Characteristics by Consumer Properties

To simplify, only the natural and external characteristics of food were considered. The study investigated which characteristics of consumers led them to prefer food based on its external features and which characteristics led them to prefer food based on its natural features. For this purpose, an analysis was conducted using separate logit models (Miran, 2003; Greene, 2018) to examine which characteristics of consumers determine their preference for foods based on their external and natural attributes (Table 15).

Table 15: Estimation results of the Logit models for Natural and External food quality characteristics

Variables	Dependent variable: Natural characteristics			Dependent variable: External characteristics		
	Coeff.	Std. Error	Slope	Coeff.	Std. Error	Slope
const	-1.205	1.510		0.572	1.094	
Male (Ref: Female)	-0.605	0.400	-0.0085	-0.531 *	0.281	-0.023
Education	0.207	0.226	0.0028	0.060	0.167	0.003
Married (Ref: Single)	-0.184	0.489	-0.0025	-0.038	0.324	-0.002
Household size	0.208	0.139	0.0028	0.171 *	0.101	0.007
Income	-0.021	0.075	-0.0003	-0.013	0.052	-0.001
Age	0.087 ***	0.028	0.0012	0.036 **	0.014	0.002
İstanbul(Ref:Antalya)	1.316 **	0.552	0.0187	0.706 *	0.410	0.030
İzmir(Ref:Antalya)	1.337	0.832	0.0122	1.216 **	0.615	0.036
Samsun(Ref:Antalya)	0.121	0.732	0.0016	-0.065	0.587	-0.003
Ankara(Ref:Antalya)	1.006 *	0.592	0.0103	0.470	0.450	0.017
Şanlıurfa(Ref:Antalya)	0.705	0.726	0.0073	0.914	0.687	0.027
Likelihood ratio test: Chi-square(11)	32.185 [0.0007]			24.056 [0.0125]		
Number of cases 'correctly predicted'	1052 (97.3%)			1023 (94.6%)		

*, **, and *** represent significance at 0.1, 0.05 and 0.01 levels, respectively.

The logit model estimations presented in Table 15 are statistically significant, correctly predicting 97% of cases for natural food quality characteristics and 94.6% of cases for external food quality characteristics. The logit model for natural food qual-

ity characteristics reveals three significant variables: age, Istanbul, and Ankara. Age has a positive relationship with the importance placed on natural food characteristics, indicating that as age increases, consumers prioritize natural attributes in their food preferences. Consumers in Istanbul and Ankara also attribute higher priority to natural food characteristics compared to Antalya.

In the logit model, which focuses on external food characteristics as the dependent variable, five variables were found to be statistically significant. Females place more importance on external characteristics of food compared to males. Larger households also attribute greater importance to external food characteristics. As consumers grow older, their preference for external properties of food tends to increase. Moreover, individuals in Istanbul and Izmir place greater emphasis on external characteristics of foods.

5. Discussion

The study confirms that healthiness is highly valued by Turkish consumers, indicating a prioritization of food quality attributes related to nutrition and freshness. This supports the theoretical background that consumers prioritize food products offering higher nutritional value and health benefits and highlights the impact of socioeconomic factors on consumer prioritization of food quality characteristics. Findings show different rankings among socioeconomic groups, with educational level and income playing a role in shaping consumer preferences. This aligns with the theoretical background that socioeconomic factors, such as income and educational level, can impact consumer priorities for food quality. Findings regarding the importance of aroma and freshness align with the hedonic theory, which suggests that consumers prioritize sensory attributes providing pleasure and satisfaction from consuming food. The emphasis on these attributes by both males and females further supports this theory.

Regarding the lower ranking of nutritional value, the findings suggest a lesser emphasis on this attribute by Turkish consumers. This can be seen as a disconfirmation between consumers' expectations and their actual experience, indicating that nutritional value may not be a primary factor in their decision-making process.

The study provides empirical evidence supporting or contradicting specific hypotheses related to consumer priorities based on food quality characteristics. It demonstrates the complex interplay between consumer preferences, socio-demographic factors, and cultural context in shaping food quality priorities. It also highlights the importance of considering diverse cultural contexts in order to enhance understanding of global consumer preferences.

Findings contribute to the theoretical understanding of consumer priorities based on food quality characteristics by providing empirical evidence from the Turkish context. Such understanding reinforces aspects of theoretical backgrounds while also

revealing contrasting findings, emphasizing the need for further research in different cultural contexts so as to gain a comprehensive understanding of consumer behaviors and preferences worldwide. Comparing the findings from the literature review with our study's findings, there are both similarities and differences concerning the emphasis placed on food quality characteristics.

Both our findings and the Ministry of Trade report emphasize the high importance of food quality for consumers. The Ministry of Trade report states that 90% of consumers consider food quality the most important characteristic when shopping, which aligns with our own findings that healthiness, freshness, and aroma are primary food quality characteristics for Turkish consumers. Petrescu et al. (2020) identified freshness, taste, and appearance as key factors influencing food quality assessment, which aligns with our study's finding that freshness and healthiness are highly valued by Turkish consumers. Anis et al. (2022), Guzek et al. (2020), and Zaibet et al. (2004) highlighted the significance of health-related cues and hygiene in consumers' decision-making processes, which is consistent with our own study's finding that healthiness is a primary food quality characteristic for Turkish consumers.

While Anis et al. suggested that nutritional attributes affected consumer food choices, our study found that nutritional value received relatively lower rankings among Turkish consumers (Anis et al., 2022). This indicates a lesser emphasis on nutritional value as a primary food quality characteristic. Lestari et al. (2022) indicated that price perception had a significant effect on customer loyalty, but our study found that price consistently received lower rankings among Turkish consumers, suggesting that it is considered the least important food characteristic. Our study mentions that educational level influences consumers' emphasis on freshness and healthiness. Magnier, Schoormans, and Mugge (2016) mention that consumers use explicit cues, such as color and price, as well as subtle cues communicated through packaging design. Our study highlights regional differences in prioritizing food quality characteristics, indicating that Turkey's diverse cuisines and eating habits lead to variations in consumer food choices. This aligns with the study by Petrescu, Vermeir, and Petrescu-Mag (2020), which found that consumers in Belgium and Romania use freshness, taste, and appearance when assessing food quality.

Both our study and the study of Gültekin & Veuphuteh (2023) highlighted the influence of socioeconomic factors on consumers' prioritization of food quality characteristics. Both studies found that different socioeconomic groups proceeded to different rankings, indicating a moderate level of agreement. Our study examined regional differences and their impact on food quality characteristics, while Aşkan et al. (2021) explored the impact of regional variations on consumers' drinking water consumption preferences.

While various studies conclude that price is significant, this study has yielded the result that price is not the most crucial factor in consumers' consideration of food

quality characteristics. This result seems to challenge the perception among consumers that higher price is indicative of higher quality in the eye of Turkish consumers.

Although there are some similarities between relevant literature findings and our study's findings regarding the importance of freshness, healthiness, and the influence of socioeconomic factors, there are also differences in the emphasis placed on nutritional value and price perception. Our study contributes to the existing literature by providing insights specific to Turkish consumers and highlighting the complex interplay between consumer preferences and sociodemographic factors in shaping food quality priorities.

The study's analysis results have yielded the following responses to the hypotheses: The study does not support the hypothesis that price has a higher priority among food quality characteristics chosen by Turkish consumers. Price consistently received lower rankings among Turkish consumers, and, even among low-income consumers, price was considered the least important food characteristic. The hypothesis that healthiness has a higher priority among food quality characteristics chosen by Turkish consumers is supported by the study. Healthiness was identified as one of the primary food quality characteristics by Turkish consumers, along with freshness and aroma. These characteristics were consistently ranked more highly regardless of consumers' income category. The findings of the study suggest that regional differences influence the priority given to food quality characteristics by Turkish consumers. Consumers in Istanbul and Izmir were found to attach more importance to external characteristics of foods. The study supports the hypothesis that socioeconomic factors influence consumers' prioritization of food quality characteristics, with different socioeconomic groups placing food quality characteristics in different ranking orders. However, the level of agreement among these groups was moderate, indicating a moderate level of concordance in assigning priority levels. The findings of the study support the hypotheses that varying levels of importance are assigned to external and natural characteristics of food. The study found that males give less importance to the external characteristics of food than females. Additionally, the larger the household, the more important the external characteristics of the food are. As age progresses, more importance is given to external properties of foods. The study also pointed out that age and geographical region have an effect on the importance given to natural characteristics of food. We summarize the results related to our hypotheses in Table 16. The study provides evidence to support the majority of the hypotheses, such as the higher priority given to healthiness and the influence of socioeconomic factors on consumers' prioritization of food quality characteristics. However, it also highlights some contrasting findings, such as the lower priority assigned to price and the regional differences in the importance of external characteristics.

Table 16: The research hypotheses and the outcome of pertinent statistical evidence

Hyphotheses	*Test*	*Result*
1: Price is of higher priority among the food quality characteristics Turkish consumers consider	Friedman test, rank #6	Reject
2: Healthiness is of a higher priority among the food quality characteristic Turkish consumers consider	Friedman test, rank #1	Accept
3: Consumers of certain characteristics tend to prefer food based on its natural features	Logit model	Accept
4: Consumers of certain characteristics tend to prefer food based on its external features	Logit model	Accept
5: Socioeconomic factors influence consumers' prioritization of food quality characteristics, i.e., different socioeconomic groups display different rankings	Friedman test	Accept

6. Implications

The priorities given by consumers to food quality characteristics primarily influence food producers and food retailers. The following recommendations can be put forward for these stakeholders. Therefore, food producers and food retailers can align their product offerings with the priorities and preferences of Turkish consumers, thereby enhancing their market competitiveness and meeting consumer demand.

Food Producers

As healthiness and freshness have been identified as the primary food quality characteristics for Turkish consumers, food producers should prioritize these aspects in their products. They should clearly communicate and promote the health benefits and

freshness of food items to appeal to consumers' preferences. Aroma was found to be significant for both males and females. Food producers should focus on enhancing the aroma of their products to attract consumers. This could involve using high-quality ingredients, incorporating aromatic spices and flavors, and ensuring proper packaging to retain the aroma. Females ranked hygiene as a higher priority feature compared to males. Food producers should pay attention to ensuring proper hygiene practices throughout production and packaging processes. They also should communicate hygiene standards and practices to build consumer trust and confidence in the products. Socio-economic groups prioritize food quality characteristics in different ranking orders. Food producers should conduct market research to understand the preferences and priorities of specific consumer population segments based on their socio-economic backgrounds. This knowledge can help tailor marketing strategies and products offered accordingly. The larger the household, the more importance was given to external characteristics of food. Food producers should consider the visual appeal, packaging, and presentation of their products to cater to the preferences of larger households. Investing in attractive packaging and appealing graphics can help attract consumers. Consumers in Istanbul and Izmir attach more importance to external characteristics of foods. Food producers should consider regional preferences and adapt their marketing strategies accordingly. This could involve highlighting the external characteristics of food products in these regions through targeted advertising or localized packaging designs. While price received lower ranking places among Turkish consumers, it still becomes a relevant factor once consumers are satisfied with the aroma, freshness, and healthiness of a food item. Food producers should strive to offer products that provide a balance between price and quality. Clearer communication of the value and benefits of products justifies the price to consumers.

The study suggests that future research should delve into the priorities of food quality characteristics in diverse cultural contexts. Food producers can contribute to this research by exploring consumer preferences within specific cultural contexts and refining their strategies accordingly.

Food Retailers

Given that healthiness and freshness hold the highest level of importance among Turkish consumers, food retailers should prioritize offering a wide selection of healthy and fresh food options. This could involve sourcing organic or locally grown produce, ensuring proper storage and handling practices, and prominently displaying the freshness of the products. Both males and females assigned significant importance to aroma, freshness, and healthiness, while females ranked hygiene as a higher priority. Food retailers should pay attention to maintaining a clean and hygienic shopping environment, as well as offering products with appealing aromas. This can be achieved through proper store maintenance, effective product placement, and stra-

tegic use of scents or natural fragrances. In the realm of food quality assessment, it is imperative to acknowledge the distinct rankings of food quality characteristics observed among various socioeconomic groups. Food retailers can tailor their product offerings and marketing strategies to cater to specific segments. For example, offering affordable options without compromising healthiness and freshness can attract low-income consumers, while highlighting premium quality and unique offerings can appeal to higher-income groups. Although price received lower rankings among Turkish consumers, it still becomes a relevant factor once consumers are satisfied with the primary characteristics. Food retailers should strive to offer competitive pricing while ensuring the quality and freshness of the products. Promote the value for money proposition through clear pricing strategies, promotions, and discounts.

Within the purview of external characteristics, it is imperative to recognize the regional disparities in their perceived significance. For consumers in Istanbul and Izmir who attach more importance to the external characteristics of foods, retailers can focus on visually appealing packaging, attractive displays, and engaging product presentation. Tailoring marketing efforts to highlight external qualities can help attract consumers in these regions.

In the context of consumer evaluations, it is essential to acknowledge the effect of educational attainment on the discernment of rankings. Food retailers can play a role in educating consumers about the importance of freshness, healthiness, and other quality characteristics. This can be done through informative signage, labeling, and engaging in-store or online content that highlights the nutritional benefits and quality features of different products. In the examination of demographic variables, specifically age and household size, it is imperative to take into consideration their impact and influence. Retailers can adapt their offerings and store layouts to accommodate the preferences of different age groups. For example, promoting convenience and ready-to-eat options for older consumers, and offering family-sized or bulk packaging options for larger households. Consumer preferences and priorities can evolve over time. Food retailers should regularly monitor consumer trends and conduct market research to stay updated on changing preferences. This will help them stay responsive to consumer demands and adjust their product assortment, marketing strategies, and store experiences accordingly.

7. Conclusion

The study's findings indicate that healthiness and freshness are highly valued by Turkish consumers, emphasizing their significance among food characteristics. On the other hand, nutritional value is given relatively lower ranking places, suggesting lesser emphasis on this attribute. The results of the tests further confirm statistically significant variations in ranking food properties, underscoring the distinct priorities assigned by consumers. Additionally, the study examines the impact of socioeconom-

ic factors on consumers' prioritization of food quality characteristics. Results reveal different rankings among socioeconomic groups, with a moderate level of agreement in assigning priority levels.

Gender differences are also noted, with both males and females assigning significant importance to aroma, freshness, and healthiness. However, females prioritize hygiene more than males. Educational level plays a role as well, with university graduates placing greater emphasis on freshness and healthiness compared to those with lower academic achievement levels.

Across various income levels, healthiness, freshness, aroma, and hygiene consistently emerge as top priorities among consumers, regardless of income category. Conversely, price, selling place, packaging, and brand are consistently placed in lower ranks. Notably, even among low-income consumers, price is considered the least important food characteristic.

The study concludes that healthiness, freshness, and aroma are identified as primary food quality characteristics by Turkish consumers. Once consumers are satisfied with these attributes, price becomes a relevant factor in their decision-making process. Moreover, factors such as age, education, income, and location are highlighted as influential in prioritizing food characteristics by consumers. Findings shed light on the complex interplay between consumer preferences and socio-demographic factors in shaping food quality priorities.

In future research, it is recommended that priorities of food quality characteristics should be explored in diverse cultural contexts so as to enhance our understanding of global consumer preferences. Such investigations would contribute towards a more comprehensive understanding of the various factors influencing consumer behaviors and preferences across different societies.

This study has revealed that price is not the most pivotal factor in consumers' assessment of food quality characteristics, contradicting the common belief that higher prices imply higher quality. On the contrary, the hypothesis that healthiness takes precedence is supported, with healthiness, freshness, and aroma identified as primary characteristics across income categories. Regional differences influence priority, particularly in Istanbul and Izmir, where external characteristics are deemed more important. Socioeconomic factors indeed impact prioritization, with different groups displaying varying ranking places and a moderate level of agreement. Additionally, the study notes gender, household size, and age differences in assigning importance to external and natural characteristics of food.

The study provides evidence that supports some hypotheses while highlighting contrasting findings. It underscores the importance of healthiness and the influence of socioeconomic factors on consumers' prioritization of food quality characteristics. Additionally, it sheds light on the lower priority given to price and regional differences concerning the importance of external characteristics.

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FOREIGN DIRECT INVESTMENT AND SUSTAINABILITY: A VISUALIZED BIBLIOMETRIC REVIEW

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Abstract

Extensive research has been conducted on the link between foreign direct investment and sustainability (FDIS). The earliest known document related to FDIS research in SCOPUS databases dates to 1992, indicating nearly three decades of ongoing research. The objective of this article is to conduct a bibliometric analysis of FDIS academic research from various perspectives. A total of 641 documents related to FDIS fields were collected and subjected to a comprehensive bibliometric analysis using state-of-the-art scientometric software. The findings from the analyses allowed us to identify leading researchers, conceptual structure, and thematic evolution of FDIS research.

Keywords: Foreign Direct Investment, Sustainability, Sustainable Development, Research Analytics, Bibliometric Review

JEL Classification:
F21: International Investment; Long-term Capital Movements
F23: Multinational Firms; International Business
C80: Data Collection and Data Estimation Methodology; Computer Programs
C88: Other Computer Software

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1. Introduction

Extensive research has been conducted on the link between foreign direct investment and sustainability. The earliest known document related to such research in Scopus databases dates to 1995. It was a presentation at the 20th Federation Economic Associations Conference, held in Singapore in December 1995, encapsulating nearly three decades of ongoing research (Koh & Wilson, 1995).

The list of review papers addressing the impact of FDI on sustainability is extensive, mainly dealing with environmental issues (Zamir & Mujahid,2022), green innovation (Tolliver et al., 2021), or focusing on certain geographic regions (Asiedu, 2021; Malefane, 2021; Nguyen & Nurul Amin, 2002). However, only one literature review has approached bibliographic data and metadata quantitatively and qualitatively using state-of-the-art scientometric software, mainly with respect to environmental concerns (Al-Nimer et al., 2022). This paper bridges this gap by providing a comprehensive analysis that incorporates both quantitative and qualitative aspects of related literature using advanced scientometric tools. The aim of this study is to provide a thorough examination of existing literature that links foreign direct investment and sustainability, making significant contributions to the field. To this end, the study employs descriptive and network bibliometric analysis techniques, which enable the authors to make three distinct contributions to related literature. The first contribution of the study is to identify the most notable and influential authors, publications, and journals in the field. By doing so, the authors can shed light on the individuals and sources that have had the greatest impact on the development of this field. The second contribution involves identifying the most frequently used author keywords and terms. This allows the authors to gain a deeper understanding of the key topics and concepts that are currently being studied. Lastly, the third contribution of the study is to identify current research trends and gaps in the literature. The authors intend to promote future research in the field of foreign direct investment and sustainability by identifying gaps that require further investigation and could potentially contribute to its ongoing development. Moreover, performing a literature review facilitates different types of analyses, including content analysis, which is regarded as the most influential form of document analysis, along with co-authorship analysis, citation analysis, and co-citation analysis. The article is organized as follows: Section 2 (Data Collection - Methodology) presents the technique and data extraction procedure employed. The subsequent section highlights the main findings of the bibliometric study, including the identification of influential authors, journals, and institutions. Following the co-author analysis, the paper concludes by addressing limitations, outlining future work, and concluding with general remarks on the research.

2. Data Collection - Methodology

A total of 250 Economics and Business journal articles out of 641 documents related to foreign direct investment and sustainability fields were collected, filtered (McInnes et al., 2018) and subjected to a comprehensive bibliometric analysis using the VOS-viewer (Van Eck & Waltman 2010) and Bibliometrix software (Aria & Cuccurullo 2017; Bitzenis et al. 2023; Bitzenis & Koutsoupias 2023; Thomos et al., 2023). The findings from the analyses allowed us to identify among others, leading researchers, top articles, country production, conceptual structure, and thematic evolution of related research. Here are some noteworthy descriptive findings from the analyzed data: the number of authors surpassed 600, with international co-authorship accounting for 28.4%, and the average number of citations per document was 20.58 (see Fig. 1).

Figure 1: Main data descriptives

As shown in Fig. 2, there is a notable increase in the yearly interest on foreign direct investment and sustainability research. It is particularly significant that almost 80% of the articles were published since 2015, indicating a significant surge in research output during that year. The present study focuses on Economics and Business-related sources based on Scopus indexing.

3. Main Findings

Well over 40 documents, and 1800 citations were contributed by the top three journals: *Journal of Cleaner Production*, *Resources Policy*, and *Environment, Development and Sustainability*.
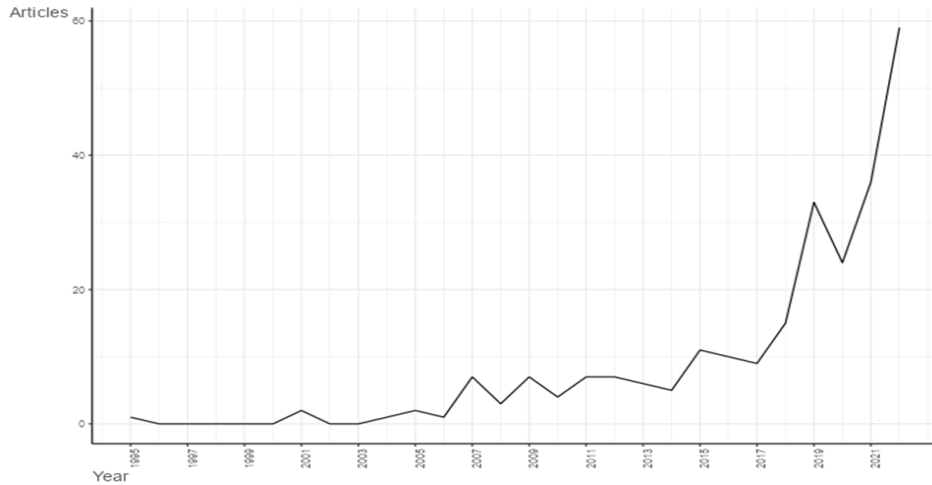
Figure 2: Annual scientific production of FDIS research

The fact that very recent FDIS articles published in the first half of 2022, such as one on future sustainability by Weimin et al. (2022) and one on renewable electricity by Mushred at al. (2022), have already garnered more than 50 citations each, is highly impressive and indicative of current scientific interest in these topics. The full list of FDIS papers can be found in the respective repository (Koutsoupias & Bitzenis, 2023a).
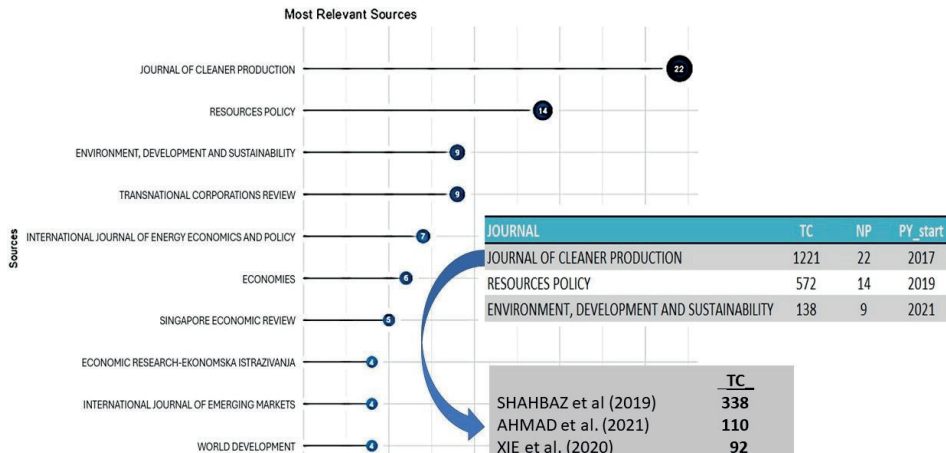

Figure 3: Most relevant sources

These journals have the highest number of related research papers, as shown in Figure 3. The *Journal of Cleaner Production* has been the most impactful, with a ratio of Total Citations (TotCit) to Articles of 55,5. Its three most popular FDIS research articles by Shahbaz et al. (2019), Ahmad et. al. (2021) and Xie et al. (2020) have accumulated over 500 references. The complete catalogue of journals with h Index > 2 that published FDIS works can be found in the corresponding repository (Koutsoupias & Bitzenis, 2023b).

Table 1: Author's impact by H index

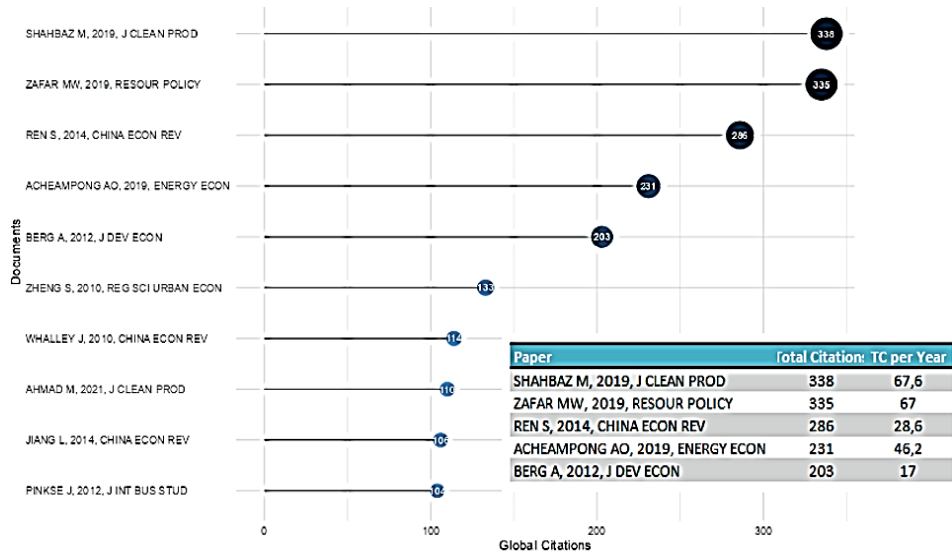| Element	h_index	TC	NP	PY_start
ZAMAN K	8	282	10	2017
NASSANI AA	7	218	9	2018
ALDAKHIL AM	6	189	6	2018
ABRO MMQ	4	141	4	2018
ANSER MK	3	31	3	2020
QAZI ABRO MM	3	61	3	2019
RIDZUAN AR	3	48	3	2017
SAUVANT KP	3	23	5	2015
SHAHBAZ M	3	414	3	2019
SUN Y	3	21	3	2010

Table 1 lists the most prolific authors with h-index of 3 or higher each, indicating their total number of citations (TotCit), the number of Papers (NP) and the year in which their first article was published (PY_start). Zaman has been recognized as the author/co-author with the greatest number of published articles in the dataset, and one of his most cited co-authored works in the *Journal of Cleaner Production* has received 64 references (Qureshi et al., 2017).
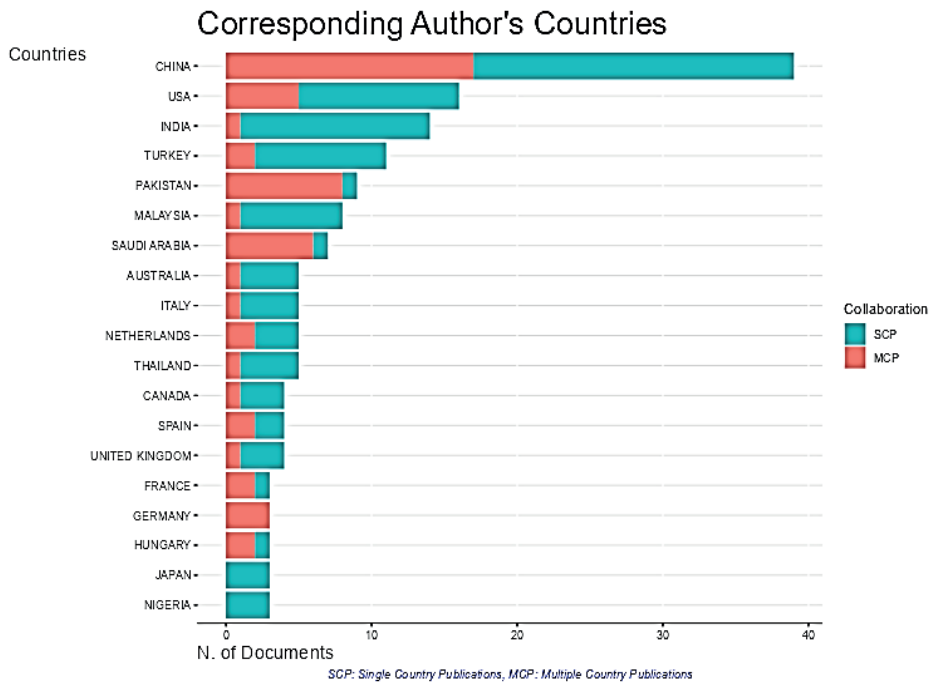
Figure 4: Corresponding author country

Nassani ranks second in terms of recognition. His most cited co-authored paper on Greek logistics in BRICS countries (Aldakhil et al. 2018) receiving 61 references. Aldakhil is third on the list, and Abro fourth, completing the catalogue of authors with more than one hundred citations of FDIS papers.

As depicted in Figure 4, China emerges as the country with the highest number of collaborative partnerships in the same publication, outnumbering other countries by a significant margin. In contrast, the United States has less than half the number of collaborating authors compared to China. In the horizontal bars, the blue color represents articles authored by individuals from the same country, while the red color signifies articles involving collaboration among multiple countries. The top five countries in terms of collaborative publications also include India, Turkey, and Pakistan. The comprehensive list of the top 30 corresponding FDIS author countries can be accessed and found published in the associated repository (Koutsoupias & Bitzenis, 2023c).

Paper	Total Citation	TC per Year
SHAHBAZ M, 2019, J CLEAN PROD	338	67,6
ZAFAR MW, 2019, RESOUR POLICY	335	67
REN S, 2014, CHINA ECON REV	286	28,6
ACHEAMPONG AO, 2019, ENERGY ECON	231	46,2
BERG A, 2012, J DEV ECON	203	17

Figure 5: Most cited documents

Figure 5 displays a compilation of papers with the highest citation count on foreign direct investment and sustainability, providing information on the total number of citations they have received and the citations per year ratio. Among these papers, more than 300 citations received one article focusing on FDI and carbon dioxide emissions (Shahbaz et al., 2019), published in the *Journal of Cleaner Production,* and one more*,* published in the *Resources Policy* focusing on the impact of natural resources*,* human capital, and FDI on the U.S. ecological footprint (Zafar et al., 2019)*.* Well above two hundred citations in the Scopus database were received by Reb at al. (2014) for a case study on Chinese carbon dioxide emissions from industrial sectors, while Acheampong's (2019) article on environmental quality received 231 citations. Berg et al. (2012) published research on growth sustainability shown as the 5th article in the FDIS list with more than 200 citations. The complete compilation of the most cited articles related to FDIS can be accessed in the associated repository (Koutsoupias & Bitzenis, 2023c), which contains a comprehensive catalog of these influential works.

Moving to a qualitative view of the research content examined, a total of 791 author keywords were analyzed. The 30 most frequent are shown here. There are over 20 occurrences of the keywords "FDI", "foreign direct investment", "sustainable development", "economic growth", and more than 10 occurrences of the following: "*sustainability*", "*China*", "*CO2 emissions*", "*financial development*" (Fig. 6).
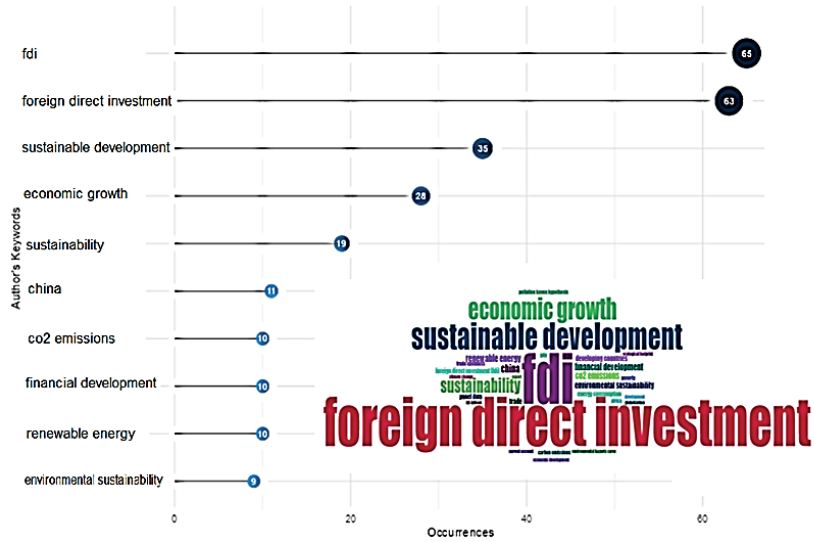
Figure 6: Most relevant keywords

As a result, it appears that, apart from the terms in focus ("FDI" and "sustainability"), studies in the examined set evolved mainly on growth and development issues.
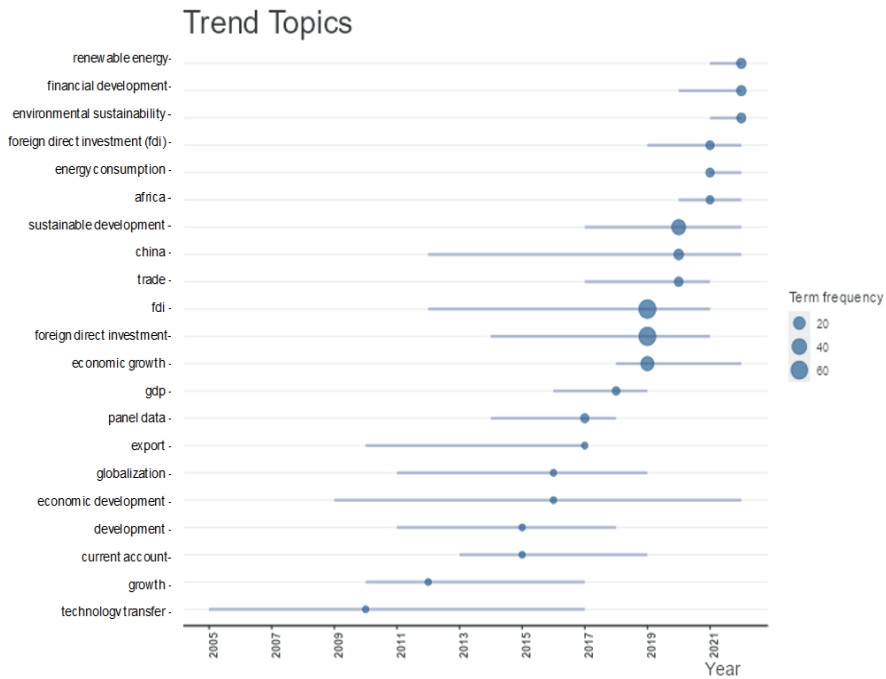

Figure 7: Trend topics

Figure 7 depicts how author keyword trends in foreign direct investment and sustainability research have evolved over time. Initially, focus was on technology transfer and growth but currently there is greater emphasis on financial development, renewable energy, and environmental sustainability. Additionally, the analysis shows that China, trade, energy consumption and Africa have gained importance in recent years. This change in emphasis becomes apparent from the longitudinal study of author keywords across the articles analyzed.

We utilized VOSviewer network data analysis software to extract a depiction of main author collaboration in the analyzed papers; this figure illustrates the collaboration network of key authors (Fig. 8). The minimum number of authors' documents has been four, and authors without connections are not presented to facilitate the interpretation of the network map. The most influential authors identified in the network are Zaman, Nassani and Aldakhil with 5 co-authored papers each, in the period between 2018 and 2022.
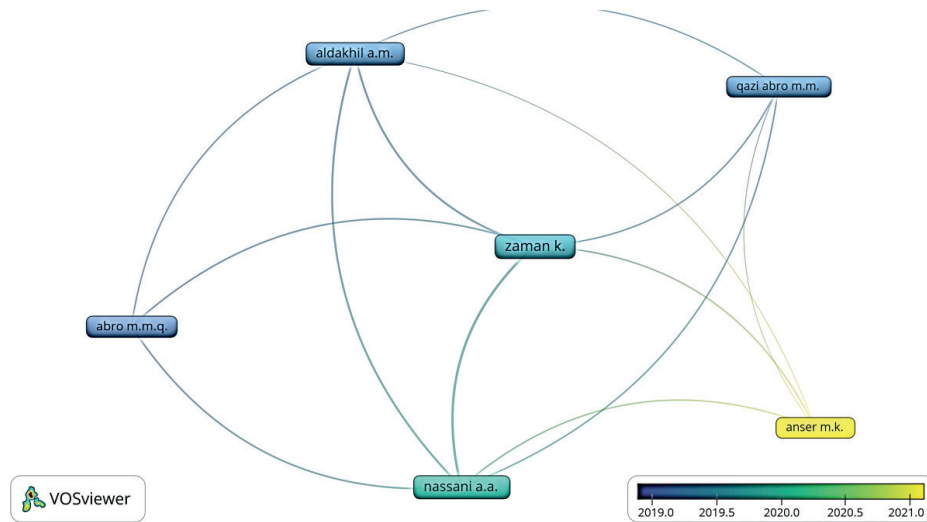
Figure 8: Main co-authorship network

Conclusions

This article helps understand the evolution of FDI-EG research from both bibliometric and review perspectives. This article provides extensive discussions on current research status, future research directions, and pros and cons of the methods employed. By adopting a bibliometric and review approach, this article facilitates better understanding of the evolution of FDIS research. Amongst the findings, a paper on the carbon dioxide emissions and FDI nexus published in the *Journal of Cleaner*

Production Energy is the most influential, while K. Zaman, China and the *Journal of Cleaner Production* are the most influential researcher, country, and journal, respectively. Based on author keywords analysis, twenty years ago, FDIS research centered on growth, technology transfer, and development, while, in the last five years, there has been a focus shift towards renewable energy, environmental sustainability, and financial development. Further discussions explore the current status of research, potential avenues for future research, and the strengths and limitations of the methods employed.

Acknowledgement:

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DRIVERS (PREDICTORS) OF GREEN MANAGEMENT PRACTICES AND GREEN INVESTMENT. EMPIRICAL EVIDENCE FROM CENTRAL AND EASTERN EUROPEAN FIRMS

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Abstract
There is a continuous need to understand and develop green practices and investments in order to emphasize environmental focus. This article's purpose is to analyze how firms from Central and Eastern Europe approach the topic of green management and correlate their decisions with their eco-friendly actions. The methodology applied is binary logistic regression and our data sample consists of 5,472 businesses/firms/companies from 12 countries. Results indicate that firms whose strategy entailed objectives regarding ecological aspects and that had set up a management position dedicated to these objectives are more likely to monitor their energy consumption, to set targets on energy consumption and CO_2 emissions and to invest in more eco-friendly machinery or heating and cooling devices. On the other hand, if the firms are experiencing losses due to pollution, there is no significant probability for them to implement the above-stated actions. This paper offers interesting implications for stakeholders and managers to understand the predictability of their actions and to assess the correlations between inside firm actions in depth.

Keywords: binary logistic regression, green investments, green management practices, predictability.
JEL Classification: Q50, C25, D22

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I. Introduction

The accelerated effects of climate change have encouraged an increasing number of both public and private entities, as well as international organizations, to develop and implement green management practices. The aim of this study is to identify and evaluate the drivers of green management practices and green investment using 5,472 firms' data from 12 Central and Eastern European countries, namely: Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Slovenia, Estonia, Lithuania, and Latvia. The data sample of our paper originate from the EBRD-EIB-WBG Enterprise Surveys conducted in 2018-2020 that covered almost 28,000 enterprises in 41 economies of the EU, Eastern Europe, Central Asia, the Middle East and North Africa.

The statistical model is based on the objectives of this study, i.e., understanding the drivers of green management practices and green investment regarding two core aspects: monitorization and targets on energy and CO_2 for the former and resource allocation for upgrading eco related aspects for the latter. Dependent variables focus on internal monitorization, external audits as well as implementing targets and investments focused on environmental benefits. The drivers selected for these variables were 7 after testing them through binary logistic regression: whether the firms had a written business strategy; whether their business strategy included aspects regarding environmental issues; whether there was a management position dedicated to environmental issues; whether there were investments in R&D inside or outside the business; whether there were losses caused by pollution or by extreme weather events.

Results indicate that the drivers (predictors) with significant predictability rates on both management practices and green investment are the presence of a management position dedicated to environmental issues and strategic objectives that mention environmental or climate change matters. Those with lower predictability rates are R&D investments within the business, a written business strategy, and losses from extreme weather events. Investments in R&D outside the business have a lower predictability rate on the majority of the selected dependent variables. On the other hand, in our model, losses due to pollution are either non-significant or reduce the likelihood of adopting green practices or investments.

This study highlights the main predictors of green management practices and green investment from Central and Eastern European firms and the significant implications these drivers have for practitioners. Companies are accountable not just for generating a profit, but also for improving society and the economy in a way that is environmentally friendly; this is why it is essential to understand what internal aspects have a positive impact on "green" actions and sustainability. Understanding which aspects of the firms can increase the predictability of green practices or investments can create a model in which actions are strongly related and have an emphasized focus on environmental aspects.

The paper is organized as follows: Section II is based on the analysis of existing literature regarding green management practices and the third part describes the data and methodology employed in the empirical study, as well as motivation. Section IV presents the empirical results and the final part highlights the conclusions, the limitations and future research opportunities.

II. Literature review

In a broad sense, sustainable investments describe responsible investments, socially conscious investments, and investments with an eye on the environment (Utz et al., 2015). The term "*green*" is a very broad definition for numerous types of activities and assets, entailing either absolute (a technology is green or not green) or relative concepts (firm X produces lower CO_2 emissions than firm Y). Regarding some industries (such as renewable energy), products (such as renewable energy credits), services (such as waste management), and technologies, there appears to be a sizable intersection of different definitions in existing literature.

The effects of climate change on institutional asset allocation are assessed by Mercer (2011), which indicates that traditional strategic asset allocation (SAA) does not take climate change into account. Three dimensions make up an evaluation framework for climate change risk: low-carbon technology; the effects of climate change; and the price of emissions brought on by policy changes. The use of green investments to strengthen sustainable development and address environmental issues results in changes in consumer behavior, as more and more consumers choose to purchase organic over conventional goods (Yen, 2018). In addition, companies whose management informs society of the advantages of the green investments they make are more likely to attract investors (Martin & Moser,2016).

Using green technology reduces specific taxes, helps meeting customer demands to consume green products and protect the environment, while it also raises stakeholders' satisfaction, especially investors' satisfaction, these being just a few of the benefits of implementing green investments. The reasons for making green investments vary as well. Understanding the various driving forces of green investors is crucial because it will influence how they define and interpret the term "green investment."

Earlier studies examined the effects of green practices on organizational performance and identified both beneficial and significant correlations between them (Cankaya & Sezen, 2019). However, there are several internal and external aspects that encourage firms to go green and, thereby, enhance their performance in terms of sustainability. Even though there are numerous external and internal drivers that influence investments and practices regarding environmental actions, it's complicated to assess these predictors, especially regarding their strength and feasibility (Table 1).

Table 1. Classification of the drivers of sustainable supply chain management

External Drivers	Internal Drivers
• Market Pressure	• Corporate Strategy
• Social Pressure	• Organizations' Culture
• Regulatory Pressure	• Organizations' Resources
	• Organizations' Characteristics

Source: Saeed & Kersten, 2019

Enterprises relying on external inputs to change take advantage of possibilities by making more sustainable investments. According to a study that examined over 5300 investment decisions at the level of 462 companies in the field of energy efficiency showed that, when using internal and external change agents simultaneously, there is no impact on the effect of external drivers (Hoppman et al., 2018). Government pressure, competitor pressure, consumer pressure, and supplier pressure are the primary external variables affecting green investment (Paul et al., 2017).

According to Du et al. (2019), the main factors influencing green investments are political, economic, and environmental. By building infrastructure and putting laws and norms into place to safeguard the environment, political issues have a significant impact on green investments. These include environmental taxes, giving discounts to customers who purchase organic items, offering subsidies to businesses making green investments, and fining businesses that violate pollution restrictions.

One of the most important topics in the literature on corporate sustainability is what motivates businesses to invest in activities linked to sustainability (Bansal & Roth, 2000; Ervin et al., 2013). Most studies assume that businesses are more motivated to invest in sustainable activities if there is a direct economic benefit, such as cost reduction or profit increase. For example, energy efficiency measures contribute both to helping the environment and to business finances, but not all companies choose to make this kind of investments even though they entail only advantages (Lyneis & Sterman, 2016; Backlund et al., 2012).

According to Marcus and Geffen (1998), a company's internal capabilities (such as organizational learning and looking for outside people, technology, and ideas) can aid in the acquisition of external skills, which are then helpful in enhancing environmental performance. Process innovation and implementation are necessary for pollution avoidance technologies to provide the firm with a low-cost advantage (Christmann, 2000). According to Sharma et al. (2004), organizations that can integrate shareholders, organizational learning, cross-functional integration, continuous innovation, shared vision, and strategic proactivity are more likely to develop green strategies.

Existing studies analyze numerous perspectives of the green actions companies take to fight climate changes. In addition, drivers with the highest impulses for im-

plement green practices and investments can be subtracted. On the other hand, in my knowledge, there is no existing study to support the main drivers (predictors) that influence green investments and practices in businesses of Central and Eastern European countries.

III.1. Data & Methodology

The European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), and the World Bank Group collaborated to create the EBRD-EIB-WB Enterprise Surveys. Nearly 28,000 businesses were surveyed as part of the EBRD-EIB-WBG Enterprise Surveys between 2018 and 2020 in 41 countries across the EU, Eastern Europe, Central Asia, the Middle East, and North Africa. The Green Economy module of the EBRD-EIB-WBG Enterprise Surveys covered green investments and green management techniques.

After data cleaning procedures and selection of the firms from Central and Eastern European countries (Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Slovenia, Estonia, Lithuania, and Latvia), the data sample comprises information for 5.742 businesses.

The purpose of the survey is to gather opinions from businesses about how they view the environment in which they operate in EBRD operational countries (and beyond), as well as to contribute to the development of a panel of business data that will enable monitoring changes in the business environment over time.

The statistical model applied in this study is **binary logistic regression** which predicts the probability that an observation falls into one of two categories of a dichotomous dependent variable. In regression analysis, logistic regression (also known as logit regression) estimates a logistic model's parameters (the coefficients in the linear combination). In binary logistic regression, there is a single binary dependent variable with two values denoted by numbers "0" and "1," whereas the independent variables can each be either a binary variable or a continuous variable (any real value). The choice of this model is based on the format of the data, mainly questions with Yes/No answers.

The article model is developed in accordance with our motivation, i.e., to understand which the internal drivers of the businesses are for selected CEE countries regarding green management practices and investments. We selected 7 independent variables (IV) as internal drivers that may influence environmentally-oriented actions: whether the firms have a written business strategy; whether the business strategy includes aspects regarding environmental issues; whether there is a management position dedicated to environmental issues; whether there are investments in R&D inside or outside the business; whether there are losses caused by pollution or by extreme weather events.

The chosen dependent variables (DV) focus on 7 important aspects regarding green practices and investments: whether businesses monitor their energy consump-

tion; whether there are targets for energy consumption and CO_2 emissions and whether resources are allocated for heating and cooling improvements, climate-friendly energy, machinery upgrades or energy management.

III.2. Motivation

The motivation of this article focuses on the need to understand if there are internal drivers that may influence green investments and practices for businesses in Central and Eastern European countries. The objective of this study is to assess whether particular actions inside the firm have the capacity to predict concerning specific environmental aspects and to provide an answer to the question: "Does any of the selected independent variables predict the probability of actions based on/regarding dependent variables?

In this study, I have identified two primary directions: green investments, focused on upgrades or changes, and green practices, which analyze and constantly evaluate consumption and pollution produced during firms' activity.

Independent Variables (Yes/No?)	Dependent variables (Yes/No?)
• Does the Firm have a Formalized Written Business Strategy?	• Over the Last 3 Years, Has This Establishment Monitored Its Energy Consumption?
• In the Last FY, Do Strategic Objectives Mention/Include Environmental or Climate Change Issues?	• Over the Last 3 Years, Has This Establishment Had Targets for Energy Consumption?
• In the Last FY, Is There a Manager Responsible for Environmental or Climate Issues?	• Does This Establishment Have Targets For CO2 Emissions?
• During the Last 3 Yrs, Has the Establishment Spent on R&D within the Establishment?	• Over the Last 3 Years, Have Heating and Cooling Improvements Been Adopted?
• During the Last 3 Yrs, Has the Establishment Spent on R&D Contracted Outside the Establishment?	• Over the Last 3 Years, Have More Climate-Friendly Energy Generation Been Adopted on Site?
• Over the Last 3 the Years, Has the Firm Experienced Monetary Losses Due to Extreme Weather Events?	• Over the Last 3 Years, Have Machinery Upgrades Been Adopted?
• Over the Last 3 Years, Has the Experienced Monetary Losses Due to Pollution?	• Over the Last 3 Years, Has Energy Management Been Adopted?

? IV predict the actions from DV

IV. Results

➢ **Descriptive statistics**

The first part of the analysis consists in understanding the data, the qualitative information, and the distribution across clusters, considering both the whole sample and the sample split by country. The sample comprises 1,215 large firms, 1,706 medium firms and 2,551 small firms (Figure 1); the distribution across countries is uneven (Figure 2.). The highest number of surveyed businesses come from Poland (1,001) and the lowest from Estonia (254).

NUMBER OF FIRMS BY SIZE
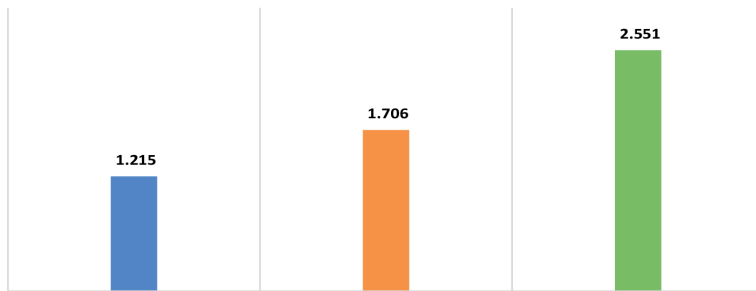
Figure 1. Number of firms by size

Figure 2. Number of firms by size & country

The highest number of firms, i.e., 1,244, are in *other services,* followed by *retail, manufacturing, food & beverages,* the lowest number, i.e., 97, being in the *textile* industry (Figure 3.).

NUMBER OF FIRMS BY INDUSTRY
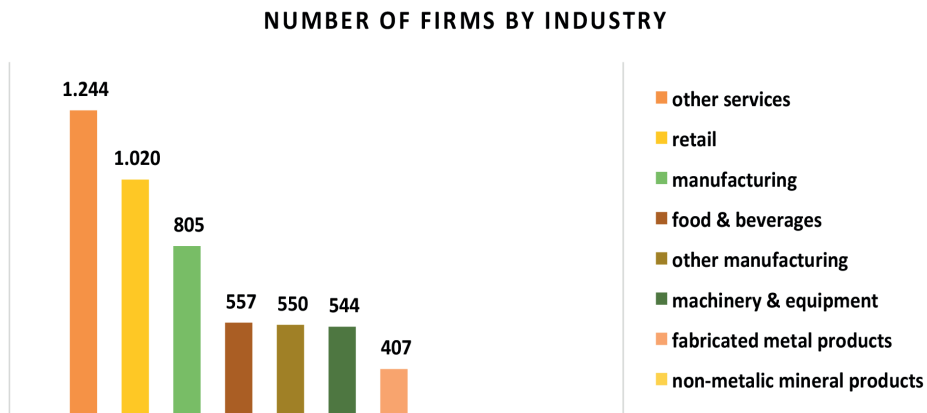
Figure 3. Number of firms by industry

A key aspect in developing our analysis and our statistical model is understanding the distribution of answers from independent and dependent variables (Figure 4. and Figure 5.).

Around 40% of the businesses surveyed have a written strategy, but only 23% of them include a focus on environmental aspects in their objectives and only 15% of the firms have a dedicated manager for green aspects. 18% of them invest in R&D inside the business and 9% outside the business. The percentages of the interviewed companies that experienced losses due to extreme weather events or pollution are only 10% and 2%, respectively.

Analysis of green practices and investments shows that 57% of the firms monitor their energy consumption, but only 30% and 7%, have targets on energy consumption and on CO_2 emissions, respectively. 38% of businesses adopt heating and cooling improvements, 14% of them adopt more climate-friendly energy generation on-site and 30% adopt energy management. The highest percentages of green investments, i.e., 51%, are observed in machinery upgrades.
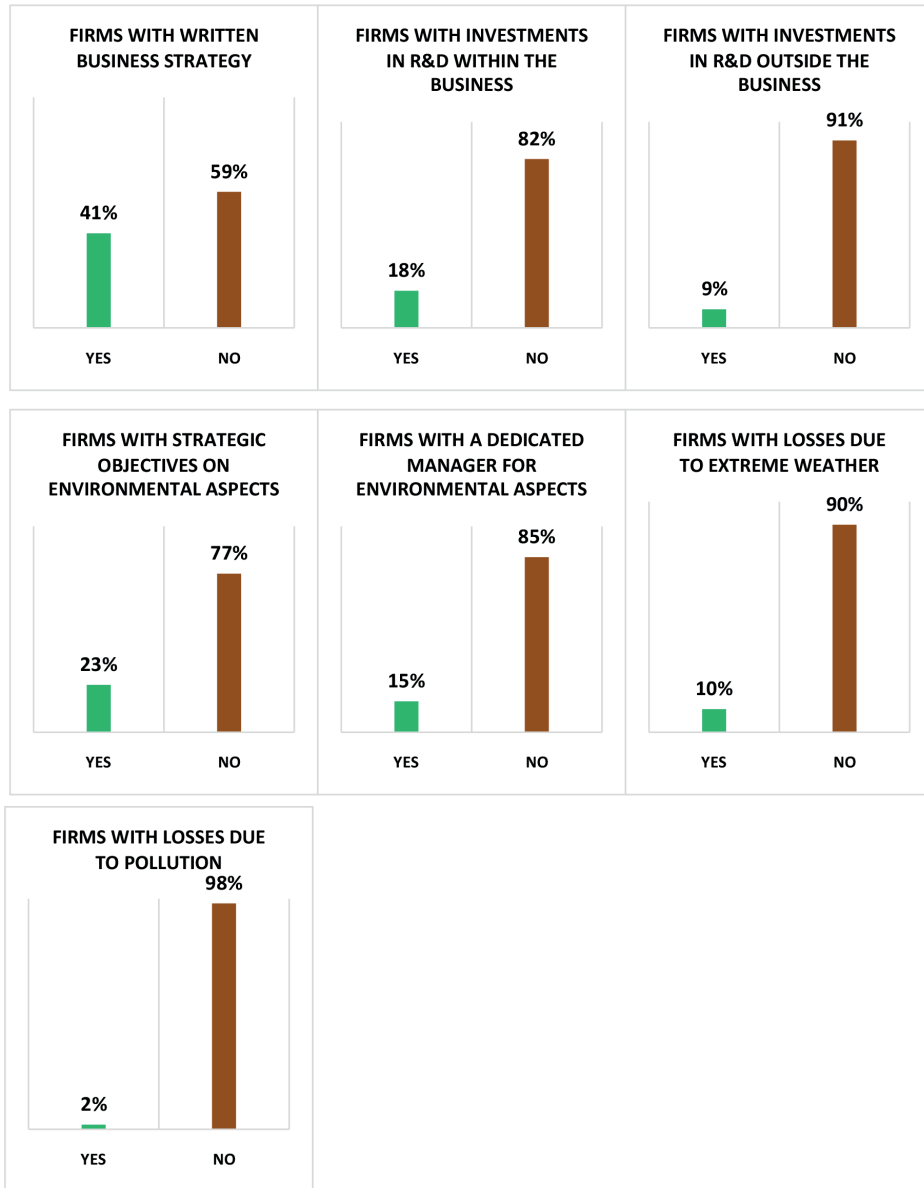
Figure 4. Distribution of answers from independent variables

Figure 5. Distribution of answers from dependent variables

➢ **Binary logistic regression**

In this part of the study the results of the binary logistics regression applied for each of the selected dependent variables will be presented.

1. Over the last 3 years, has this establishment monitored its energy consumption?

Research question: Can we predict whether the establishment monitored its energy consumption based on whether it had a written business strategy, whether it invested in R&D inside or outside the business? On whether the business strategy included aspects regarding environmental issues, whether there was a management position dedicated to environmental issues and whether the firm experienced losses due to extreme weather or pollution?

Table 2. Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.301	.027	121.361	1	.000	1.352

Table 3. Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	589.514	7	.000
	Block	589.514	7	.000
	Model	589.514	7	.000

We can observe a statistically significant result in Sig. value, lower than 5% (Table 2.). The overall model is statistically significant, $\chi2(7) = 589.514$, $p < .05$ (Table 3.).

Table 4. Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	6873.548[a]	.102	.137
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.			

Both Cox & Snell and Nagelkerke R Square values, used to calculate the variation explained, are listed in Table 4. Sometimes referred to as "pseudo R2 values," these values are interpreted in the same manner; in other words, the variation explained in the dependent variable is based on our model ranges from 10.2% to 13.7%, depend-

ing on whether we reference the Cox & Snell R2 or the Nagelkerke R2 methods, respectively.

Table 5. Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	4.994	5	.417

The Hosmer-Lemeshow test examines the null hypothesis that the model's predictions exactly match the group memberships observed. When comparing the frequencies observed to those predicted by the linear model, a chi-square statistic is calculated. A non-significant chi-square and Sig mean that the data were well-fitted to the model (Table 5).

Table 6. Classification Table[a]					
	Observed			Predicted	
		monitor_energy_ consumption		Percentage Correct	
		no	yes		
Step 1	monitor_energy_consumption	no	1310	1017	56.3
		yes	1014	2131	67.8
	Overall Percentage				62.9
a. The cut value is .500					

With the independent variables added, the model now correctly classifies 62.9% of overall cases (see "Overall Percentage" row), a Percentage accuracy in classification.

- 67.8 % of businesses that monitor their energy consumption were also predicted by the model to monitor their energy consumption (see the "Percentage Correct" column in the "Yes" row of the categories observed)   Sensitivity

- 56.3 % of businesses that did not monitor their energy consumption were correctly predicted by the model not to be monitoring their energy consumption (see the "Percentage Correct" column in the "No" row of the categories observed) Specificity

Table 7. Categorical Variables Codings		Frequency (1)	Parameter coding
written_strategy	no	3210	1.000
	yes	2262	.000

Table 7. shows us that the written strategy was parameter coded as no (1) = 1 and yes (1) =0.

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	written_strategy(1)	-.316	.062	25.945	1	.000	.729	.645	.823
	RnD_within_business	**.790**	**.097**	**66.685**	**1**	**.000**	**2.204**	1.823	2.665
	RnD_outside_business	.600	.146	16.939	1	.000	1.821	1.369	2.423
	strategic_environment	.428	.087	24.452	1	.000	1.534	1.295	1.818
	environment_manager	**.758**	**.109**	**48.594**	**1**	**.000**	**2.134**	1.724	2.641
	losses_weather	**.793**	**.116**	**47.023**	**1**	**.000**	**2.210**	1.762	2.773
	losses_pollution	-.025	.231	.012	1	.913	.975	.620	1.534
	Constant	.084	.055	2.309	1	.129	1.088		

Table 8. Variables in the Equation

a. Variable(s) entered on step 1: written_strategy, RnD_within_business, RnD_outside_business, strategic_environment, environment_manager, losses_weather, losses_pollution.

As Table 8. presents, The Wald test ("Wald" column) is used to determine statistical significance for each of the independent variables. The statistical significance of the test is found in the "Sig." column. From these results it is apparent that written strategy (p = .000), R&D within the business (p = .000), R&D outside the business (p= .000), strategic_environment (p= .000), environment_manager (p= .000) and losses_weather (p = .000) significantly added to the model/prediction, but losses_pollution (p = .913) did not significantly add to the model/prediction.

A binary logistic regression was performed to ascertain the effects of written business strategy, investments in R&D inside or outside the business, business strategy including aspects regarding environmental issues, a management position dedicated to environmental issues and losses experienced due to extreme weather or pollution on the likelihood of participants having monitored their energy consumption in the last 3 years. The logistic regression model was statistically significant, i.e., $\chi2(7)$ = 589.514, p < .05. The model explained 13.7 % (Nagelkerke R2) of the variance in monitoring energy consumption and correctly classified 62.9% of cases.

Firms without a written business strategy were associated with a reduction (0.729) in the likelihood of monitoring energy consumption. On the other hand, firms that invest in R&D within and outside the business presented a figure of 2.204, which means they are 1.821 times more likely to monitor their energy consumption. A simi-

larly increased likelihood can be observed for the firms that have strategic objectives regarding the environment (1.534), a dedicated manager for environmental issues (2.134) and that have experienced losses due to extreme weather events (2.210). However, losses due to pollution have no statistical significance on the model (Sig = .913).

2. Over the last 3 years, has this establishment set targets on energy consumption?

Research question: Can we predict whether the establishment sets targets on energy consumption based on whether it has a written business strategy, invests in R&D inside or outside the business, its business strategy includes aspects regarding environmental issues, has a management position dedicated to environmental issues and experienced losses due to extreme weather or pollution?

We will apply the same binary logistic regression interpretation as in Sub-chapter 1.

Table 9. Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.829	.029	795.055	1	.000	.437

Table 10. Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	914.898	7	.000
	Block	914.898	7	.000
	Model	914.898	7	.000

Table 11. Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	5806.268[a]	.154	.218
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.			

Table 12. Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	13.687	5	.018

Table 13. Classification Table[a]

	Observed		Predicted		
		targets_energy_ consumption	Percentage Correct		
		no	yes		
Step 1	targets_energy_ consumption	no	3536	273	92.8
		yes	1109	554	33.3
	Overall Percentage				74.7

Table 14. Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	**written_strategy**	**.624**	**.067**	**85.846**	**1**	**.000**	**1.866**	1.636	2.130
	RnD_within_business	.602	.091	44.281	1	.000	1.827	1.530	2.181
	RnD_outside_business	.247	.123	4.037	1	.045	1.280	1.006	1.627
	strategic_environment	**1.062**	**.082**	**166.939**	**1**	**.000**	**2.892**	2.461	3.397
	environment_manager	.597	.096	38.983	1	.000	1.817	1.507	2.192
	losses_weather	.611	.105	33.568	1	.000	1.842	1.498	2.265
	losses_pollution	-.366	.210	3.037	1	.081	.694	.460	1.047
	Constant	-1.706	.049	1199.733	1	.000	.182		

a. Variable(s) entered on step 1: written_strategy, RnD_within_business, RnD_outside_business, strategic_environment, environment_manager, losses_weather, losses_pollution.

A binary logistic regression was performed to ascertain the effects of written business strategy, investments in R&D inside or outside the business, the business strategy includes aspects regarding environmental issues, a management position dedicated to environmental issues and of the experienced losses due to extreme weather or pollution on the likelihood of participants having set targets on energy consumption in the last 3 years. The logistic regression model was statistically significant, $\chi2(7)$ = 914.898, p < .05. The model explained 21,8% (Nagelkerke R2) of the variance in targets on energy consumption and correctly classified 74,7% of cases.

Firms with a written business strategy were associated with an increase (1.866) in the likelihood of having targets on energy consumption. Firms that invest in R&D within and outside the business presented a figure of 1.827 which means they are

1.280 times more likely to target their energy consumption. A similarly increased likelihood can be observed for firms that have strategic objectives regarding the environment (2.892), a dedicated manager for environmental issues (1.817) and with experience of losses due to extreme weather events (1.842). On the other hand, losses due to pollution have no statistical significance on the model (Sig = .081).

3. Did this establishment set targets for CO_2 emissions?

Research question: Can we predict whether the establishment set targets for CO2 based on whether it has a written business strategy, invests in R&D inside or outside the business, has a business strategy including aspects regarding environmental issues, has a management position dedicated to environmental issues and experienced losses due to extreme weather or pollution?

We will apply the same binary logistic regression interpretation as in Sub-chapter 1.

Table 15. Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-2.618	.054	2376.513	1	.000	.073

Table 16. Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	535.099	7	.000
	Block	535.099	7	.000
	Model	535.099	7	.000

Table 17. Model Summary			
Step	-2 Log likeli-hood	Cox & Snell R Square	Nagelkerke R Square
1	2183.266[a]	.093	.238
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.			

Table 18. Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	9.465	5	.092

Table 19. Classification Table (a)					
	Observed			Predicted	
			targets_CO2		Percentage Correct
			no	yes	
Step 1	targets_CO2	no	5094	6	99.9
		yes	367	5	1.3
	Overall Percentage				93.2
a. The cut value is .500					

Table 20. Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 (a)	written_strategy	.524	.133	15.621	1	.000	1.689	1.302	2.189
	RnD_within_business	.415	.144	8.259	1	.004	1.514	1.141	2.010
	RnD_outside_business	.262	.170	2.371	1	.124	1.299	.931	1.814
	strategic_environment	**1.419**	**.144**	**97.535**	**1**	**.000**	**4.134**	**3.119**	**5.479**
	environment_manager	**.926**	**.136**	**46.377**	**1**	**.000**	**2.524**	**1.933**	**3.294**
	losses_weather	.441	.157	7.905	1	.005	1.555	1.143	2.115
	losses_pollution	.441	.248	3.173	1	.075	1.555	.957	2.527
	Constant	-4.033	.118	1.174.101	1	.000	.018		
a. Variable(s) entered on step 1: written_strategy, RnD_within_business, RnD_outside_business, strategic_environment, environment_manager, losses_weather, losses_pollution									

A binary logistic regression was performed to ascertain the effects of written business strategy, investments in R&D inside or outside the firm, a business strategy including aspects regarding environmental issues, a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution on the likelihood of participants having set targets for CO_2 emissions. The logistic regression model was statistically significant, i.e., $\chi2(7) = 535.099$, $p < .05$. The model explained 23.8% (Nagelkerke $R2$) of the variance in targets for CO_2 emissions and correctly classified 93.2% of cases.

Firms with a written business strategy were associated with an increase (1.689) in the likelihood of having targets for CO_2 emissions. Firms that invest in R&D within the business are 1.514 times more likely to target their CO_2 emissions. A similarly increased likelihood can be observed among firms with strategic objectives regarding

the environment (4.134), a dedicated manager for environmental issues (2.524) and experience of losses due to extreme weather events (1.555). On the other hand, investments in R&D outside the business and losses due to pollution have no statistical significance on the model (Sig = .913 and Sig = .07, respectively.).

4. Over the last 3 years, have heating and cooling improvements been adopted?

Research question: Can we predict whether the establishment adopted heating and cooling improvements based on whether it has a written business strategy, it invests in R&D inside or outside the business, has a business strategy including aspects regarding environmental issues, has a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution?

We will apply the same binary logistic regression interpretation as in the Subchapter 1.

Table 21. Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.487	.028	305.621	1	.000	.615

Table 22. Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	532.689	7	.000
	Block	532.689	7	.000
	Model	532.689	7	.000

Table 23. Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	6738.382[a]	.093	.126
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.			

Table 24. Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	12.682	5	.027

Table 25. Classification Table[a]					
	Observed			Predicted	
		heating_improve-ments		Percent-age Cor-rect	
		no	yes		
Step 1	heating_improvements	no	2997	392	88.4
		yes	1385	698	33.5
	Overall Percentage				67.5
a. The cut value is .500					

Table 26. Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	
								Upper	
Step 1[a]	written_strategy	.330	.062	28.061	1	.000	1.392	1.231	1.573
	RnD_within_business	**.610**	**.086**	**50.547**	**1**	**.000**	**1.841**	1.556	2.178
	RnD_outside_business	.511	.119	18.426	1	.000	1.667	1.320	2.105
	strategic_environment	**.639**	**.080**	**63.152**	**1**	**.000**	**1.895**	1.618	2.218
	environment_manager	.436	.094	21.702	1	.000	1.546	1.287	1.857
	losses_weather	.385	.101	14.592	1	.000	1.470	1.206	1.791
	losses_pollution	-.257	.199	1.662	1	.197	.774	.523	1.143
	Constant	-1.043	.042	624.108	1	.000	.353		
a. Variable(s) entered on step 1: written_strategy, RnD_within_business, RnD_outside_business, strategic_environment, environment_manager, losses_weather, losses_pollution.									

A binary logistic regression was performed to ascertain the effects of written business strategy, investments in R&D inside or outside the business, a business strategy including asingpects regarding environmental issues, a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution on the likelihood of firms having adopted healing and cooling improvements. The logistic regression model was statistically significant, with $\chi2(7) = 532.689$, $p < .05$. The model explained 12.6% (Nagelkerke $R2$) of the variance of firms that had adopted healing and cooling improvements and correctly classified 67.5% of cases.

Firms with a written business strategy were associated with an increase (1.392) in the likelihood of having adopted healing and cooling improvements. Firms that invest in R&D within and outside the business present a figure of 1.841, which means they

are 1.667 times more likely to adopt healing and cooling improvements. A similarly increased likelihood can be observed among firms with strategic objectives regarding the environment (1.895), a dedicated manager for environmental issues (1.546) and experience of losses due to extreme weather events (1.470). On the other hand, losses due to pollution have no statistical significance on the model (Sig = .197).

5. Over the last 3 years, have more climate-friendly energy generation been adopted on site?

Research question: Can we predict whether the establishment adopted more climate-friendly energy generation on site based on whether it has a written business strategy, it invests in R&D inside or outside the business, has a business strategy including aspects regarding environmental issues, has a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution?

We will apply the same binary logistic regression interpretation as in Sub-chapter 1.

Table 27. Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.832	.039	2184.829	1	.000	.160

Table 28. Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	501.238	7	.000
	Block	501.238	7	.000
	Model	501.238	7	.000

Table 29. Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	3890.269[a]	.088	.159
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.			

Table 30. Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	6.640	4	.156

Table 31. Classification Table[a]					
	Observed			Predicted	
		climate_friendly_energy		Percentage Correct	
		no	yes		
Step 1	climate_friendly_energy	no	4697	20	99.6
		yes	740	15	2.0
	Overall Percentage				86.1
a. The cut value is .500					

Table 32. Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	**written_strategy**	**.438**	**.090**	**23.551**	**1**	**.000**	**1.549**	1.298	1.848
	RnD_within_business	.396	.110	13.070	1	.000	1.486	1.199	1.843
	RnD_outside_business	.125	.139	.812	1	.367	1.133	.863	1.488
	strategic_environment	**1.242**	**.100**	**153.778**	**1**	**.000**	**3.463**	2.846	4.215
	environment_manager	.366	.109	11.337	1	.001	1.441	1.165	1.783
	losses_weather	.200	.127	2.504	1	.114	1.222	.953	1.566
	losses_pollution	.301	.217	1.919	1	.166	1.351	.883	2.069
	Constant	-2.696	.070	1496.708	1	.000	.067		
a. Variable(s) entered on step 1: written_strategy, RnD_within_business, RnD_outside_business, strategic_environment, environment_manager, losses_weather, losses_pollution.									

A binary logistic regression was performed to ascertain the effects of a written business strategy, investments in R&D inside or outside the business, a business strategy including aspects regarding environmental issues, a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution on the likelihood of firms having more climate-friendly energy generation on site. The logistic regression model was statistically significant, i.e., $\chi 2(7) =$ 501.238, p < .05. The model explained 15.6% (Nagelkerke R2) of the variance of firms that have adopted more climate-friendly energy generation on site and correctly classified 86.1% of cases.

Firms with a written business strategy were associated with an increase (1.549) in the likelihood of having adopted more climate-friendly energy generation on site.

Firms that invest in R&D within the business are 1.496 times more likely to adopt more climate-friendly energy generation on site. A similarly increased likelihood can be observed for firms with strategic objectives regarding the environment (3.463) and a dedicated manager for environmental issues (1.441). On the other hand, investments in R&D outside the business, losses due to extreme weather events and pollution have no statistical significance on the model (Sig = .367; Sig= .114; Sig= .166).

6. Over the last 3 years, have machinery upgrades been adopted?

Research question: Can we predict whether the establishment adopted machinery upgrades based on whether it has a written business strategy, it invests in R&D inside or outside the business, has a business strategy including aspects regarding environmental issues, has a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution?

We will apply the same binary logistic regression interpretation as in Sub-chapter 1.

Table 33. Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.053	.027	3.789	1	.052	1.054

Table 34. Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	631.482	7	.000
	Block	631.482	7	.000
	Model	631.482	7	.000

Table 35. Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	6950.531[a]	.109	.145
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.			

Table 36. Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	27.987	5	.000

Table 37. Classification Table[a]					
	Observed			Predicted	
		machinery_upgrades		Percent-	
		no	yes	age Correct	
Step 1	machinery_upgrades	no	2031	633	76.2
		yes	1289	1519	54.1
	Overall Percentage				64.9

Table 38. Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	written_strategy	.277	.061	20.391	1	.000	1.319	1.170	1.488
	RnD_within_business	**.928**	**.093**	**99.066**	**1**	**.000**	**2.530**	2.108	3.038
	RnD_outside_business	.415	.134	9.545	1	.002	1.514	1.164	1.969
	strategic_environment	.553	.084	43.363	1	.000	1.739	1.475	2.050
	environment_man-ager	**.733**	**.103**	**50.868**	**1**	**.000**	**2.081**	1.701	2.545
	losses_weather	.567	.107	28.065	1	.000	1.762	1.429	2.174
	losses_pollution	-.734	.207	12.583	1	.000	**.480**	.320	.720
	Constant	-.490	.039	159.070	1	.000	.613		
a. Variable(s) entered on step 1: written_strategy, RnD_within_business, RnD_outside_business, strategic_environment, environment_manager, losses_weather, losses_pollution.									

A binary logistic regression was performed to ascertain the effects of a written business strategy, investments in R&D inside or outside the business, a business strategy including aspects regarding environmental issues, a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution on the likelihood of firms adopting machinery upgrades. The logistic regression model was statistically significant, with $\chi 2(7) = 631.482$, $p < .10$. The model explained 145% (Nagelkerke $R2$) of the variance of firms having adopted machinery upgrades and correctly classified 64.9% of cases.

Firms with a written business strategy were associated with an increase (1.319) in the likelihood of having adopted more climate-friendly energy generation on site. Firms that invest in R&D within and outside the business present a figure of 2.539,

which means it is 1.514 times more likely to adopt machinery upgrades. A similarly increased likelihood can be observed for firms with strategic objectives regarding the environment (1.739), with a dedicated manager for environmental issues (2.081), and for firms that experienced losses due to extreme weather events (1.762). On the other hand, losses due to pollution reduce the likelihood of firms adopting machinery upgrades by 0.480 times.

7. Over the last 3 years, has energy management been adopted?

Research question: Can we predict whether the establishment adopted energy management based on whether it has a written business strategy, it invests in R&D inside or outside the business, has a business strategy including aspects regarding environmental issues, has a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution?

We will apply the same binary logistic regression interpretation as in Sub-chapter 1.

Table 39. Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.840	.029	813.178	1	.000	.432

Table 40. Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	720.638	7	.000
	Block	720.638	7	.000
	Model	720.638	7	.000

Table 41. Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	5978.835[a]	.123	.175
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.			

Table 42. Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	14.703	6	.023

Table 43. Classification Table[a]					
	Observed		Predicted		
		energy_management		Percentage	
		no	yes	Correct	
Step 1	energy_management	no	3516	306	92.0
		yes	1107	543	32.9
	Overall Percentage				74.2

Table 44. Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper	
Step 1[a]	written_strategy	.389	.067	33.707	1	.000	1.476	1.294	1.683
	RnD_within_business	.607	.089	46.492	1	.000	1.835	1.541	2.184
	RnD_outside_business	.310	.120	6.655	1	.010	1.364	1.077	1.726
	strategic_environment	**.861**	**.082**	**110.694**	**1**	**.000**	**2.367**	2.016	2.779
	environment_manager	**.748**	**.094**	**63.312**	**1**	**.000**	**2.112**	1.757	2.539
	losses_weather	.329	.105	9.791	1	.002	1.389	1.131	1.707
	losses_pollution	-.416	.207	4.050	1	.044	**.660**	.440	.989
	Constant	-1.550	.047	1082.366	1	.000	.212		
a. Variable(s) entered on step 1: written_strategy, RnD_within_business, RnD_outside_business, strategic_environment, environment_manager, losses_weather, losses_pollution.									

A binary logistic regression was performed to ascertain the effects of a written business strategy, investments in R&D inside or outside the business, a business strategy including aspects regarding environmental issues, a management position dedicated to environmental issues and experience of losses due to extreme weather or pollution on the likelihood of firms adopting energy management. The logistic regression model was statistically significant, with $\chi2(7) = 720.638$, $p < .05$. The model explained 17.5% (Nagelkerke $R2$) of the variance of firms having adopted energy management and correctly classified 74.2% of cases.

Firms with a written business strategy were associated with an increase (1.476) in the likelihood of firms having adopted more climate-friendly energy generation on site. Firms that invest in R&D within and outside the business present a figure of

1.835, which means they are 1.364 times more likely to adopt machinery upgrades. A similarly increased likelihood can be observed for the firms that have strategic objectives regarding the environment (2.367), a dedicated manager for environmental issues (2.112), and experience of losses due to extreme weather events (1.389). On the other hand, losses due to pollution reduce the likelihood of firms' adopting machinery upgrades by 0.660 times.

V. Conclusions

People anticipate/expect that managers use resources smartly and responsibly, safeguard the environment, reduce the amount of air/gas, water, energy, minerals, and other materials found in the finished goods people consume, recycle these goods to the fullest extent possible, and reuse them as much as possible rather than depend on nature to resupply them. The requirement for environmentally friendly management is unavoidable from a moral or normative standpoint, and whether becoming green "pays" or not is only partially relevant (Marcus & Fremeth, 2009).

The need to determine whether there are internal forces that might have an impact on green investments and business practices in countries in Central and Eastern Europe is the motivation behind this article. This study aims to determine whether specific business activities may anticipate certain environmental factors and to answer the question: Which of the chosen independent variables can predict the likelihood of actions based on/regarding dependent variables?

Findings demonstrate that the presence of a management position dedicated to environmental issues and the presence of environmental or climate change issues in strategic objectives are drivers (predictors) with significant predictability on the likelihood of both management practices and green investment by companies. A firm's R&D expenditures, documented business strategies, and losses due to extreme weather incidents, all have lower predictability indices. The bulk of the dependent variables chosen is less predictable when R&D investments are made outside the firm. On the other hand, costs associated with pollution either don't matter in our model or make adopting green investments or activities less likely.

There are several limitations in this study, mainly due to the variables chosen, that may not concern all essential green practices and investments. For example, the article can be extended by choosing more predictors or other examples of variables, such as other/more/different environmental targets, diversity of employees, financial practices, etc. In addition, the sample can be extended to include other/more countries in Europe or other continents.

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SUSTAINABILITY AND INNOVATION: THE CASE OF INDUSTRY 4.0

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Abstract

In the last years, sustainability is increasing in popularity not only among firms but also among their stakeholders. In addition to a growth in sales, companies can improve their financial and investment opportunities as well as reduce operational costs and become more productive, minimize carbon fossil used and improve energy efficiency, opting for renewable opportunities, such as solar energy and wind power. According to the literature, there seems to be a correlation between sustainable companies and innovation. Therefore, advanced technologies may contribute to sustainability. This is the case of the Fourth Industrial revolution, an industry paradigm shift introducing many new technologies. Thanks to such technologies, it is indeed possible to monitor and reduce emissions, diminish waste and have a more efficient production. Research suggests that there are differences as larger firms are more technologically advanced and more innovative than smaller ones. Assuming that technological level is an indicator of sustainable practices, the objective of this paper was to assess differences at technological level among micro, small, medium and large companies. This was achieved by analyzing data of a survey conducted in Slovakia and Italy, the respondents to which were owners and managers.

Keywords: Sustainability, Industry 4.0, Digitalization.

JEL Classification: O30, O33, Q56

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1. Introduction

Policy makers, consumers and other stakeholders – including many employees enthusiastic about greener production - are now demanding products made using sustainable practices. This is due to an increasing awareness of the importance of fighting climate change and being more environmentally friendly. Consumers are then likely to reward companies compliant with these principles by purchasing from and being loyal to them even if their products are more expensive. Similarly, investors may decide to invest in sustainable companies as they are more appealing from a financial perspective; in other words, sustainability increases a firm's value. Moreover, all economic activity is dependent on and conditioned by both renewable and nonrenewable natural resources (Rout, Verma, Bhunia, Surampalli, Zhang, Tyagi, Brar & Goyal, 2020). Therefore, their wise consumption and use in production are a must.

The perception of a global environmental crisis initially appeared in governments' agendas in the middle of the 20th century, but it was only in 1987 that the World Commission on Environment and Development (WCED) was formed (Lazaretti, Giotto, Sehnem & Bencke, 2019). As a result, certain practices that were performed by firms in the last century are now done differently and no longer accepted because they harm the environment. Indeed, in the past, there was no or little concern regarding sustainable practices and in respect to the damage firms might inflict to the environment. Technology development can enhance sustainable practices by ensuring improved efficiency and using resources better. Nevertheless, it often occurs that the availability of these technologies has the opposite outcome: increased pollution and resource overuse (Rout et al., 2020).

Hopefully, thanks to very advanced technologies, firms can be sustainable in their everyday routines. The paradigm shift towards Industry 4.0 (I4.0) (the Fourth industrial revolution) makes sustainability possible and is characterized by such technologies, which offer efficient solutions for energy savings, control of emissions and machinery maintenance (Garetti & Taisch, 2012). Nonetheless, I4.0 does not necessarily mean inevitable sustainability: sustainability and I4.0 should be considered jointly, i.e. the former should be "the very core of the Industry 4.0 strategy" (Piccarozzi, Aquilani & Gatti, 2018, p. 19). What is more, sustainability is a central issue when planning innovation and formulating new strategies (Adams, Jeanrenaud, Bessant, Denyer & Overy, 2016). In the agricultural sector, the paradigm shift is known as Agriculture 4.0, and it improves traditional farming practices that allow farms to ensure sustainability of agricultural and agrifood production processes as well as transparency of their operations (Spanaki, Karafili & Despoudi, 2021). In addition to agriculture, I4.0 can be adapted to every sector, industries, and companies regardless of their size.

The objective of this paper was to assess the technological level of companies of different sizes, specifically micro, small, medium, and large companies. The rest of the article is organized as follows: First, there is a literature review conducted on

sustainability and the ways in which I4.0 can support and enhance it; then the methodology used to analyze the questionnaire is presented and the last part presents a discussion based on our results.

1.1 Sustainability and Industry 4.0: a literature review

In this section, sustainability and I4.0, as well as the role of the latter in enhancing green practices in meeting the principles of sustainable development, are examined.

Sustainability is a wide concept that stresses the importance to preserve resources so that future generations can also make use of them. Indeed, sustainable development recognizes the interdependence of environmental, i.e. the impact of natural resources and pollutant emissions, social impacts of innovations on communities within which the organization carries out its business, and efficient economic systems (Khan, 2016). Such balanced integrated policies concerning society, the environment, and economy are to the advantage of current and future generations (Geissdoerfer, Savaget, Bocken & Hultink, 2017). Since the 1970s, the three have been jointly referred to as the pillars of sustainability, although some papers also include other aspects, such as institutional, cultural, and technical (Purvis, Mao & Robinson, 2019). However, it is possible to argue that these additional dimensions are already included in the three pillars. Another name to refer to them is, among others, three bottom pillars (TBP). Externalities of socio-environmental and economic parameters affect the pillars (El Baz, Tiwari, Akenroye, Cherrafi & Derrouiche, 2022).

A more specific concept of sustainability for firms is business sustainability. This is the ability to generate resources so as to compensate production factors (i.e. inputs), to replace used assets, and to invest and maintain competitiveness (Barbieri, Vasconcelos, Andreassi & Vasconcelos, 2010 cited in Kuzma, Padilha, Sehnem, Julkovski & Roman, 2020), the aim being to positively affect society as a whole (note that the basic pillars are included in this definition, too). Moreover, today's sustainable businesses must effectively fulfil social, financial, and profitability objectives and this can significantly contribute to financial and environmental problems (Javaid, Haleem, Singh, Suman & Gonzalez, 2022). The environmental and social dimensions of sustainability should be considered of equal importance to economic ones, i.e. the pillar most studied (Piccarozzi, Silvestri, Aquilan & Silvestri, 2022) – namely profitability in business and market share – when formulating strategies (Kuzma et al., 2020). This is the only way firms can aspire to be really sustainable since all the three pillars are valued and balanced.

Even the choice of suppliers is relevant if a firm seeks true sustainability. Apple and Dell had suppliers whose employees had to work in dangerous conditions to produce the electronic parts; Nike and Adidas' suppliers were dumping toxins into rivers in China. In order to avoid these undesirable behaviors, firms have to establish long-term sustainability goals and demand first-tier (the closest to the firm) suppliers to set their own long-term sustainability goals; the overall sustainability strategy

should include lower-tier suppliers, too (Villena & Gioia, 2020). There are diverse tools to perform supplier sustainability assessments (Lee & Kashmanian, 2013 cited in Matthess, Kunkel, Xue & Beier, 2022).

According to the literature, there seems to be a correlation between innovating firms and sustainability. Nidumolu, Prahalad and Rangaswami (2009) argue that innovation is a great supporter of sustainable development and provides a competitive advantage (cited in Lazaretti et al., 2019). From the literature review by Piccarozzi et al. (2022), it is generally possible to find a positive relation, not always precisely quantifiable, that emphasizes "a positive potential impact of innovations on sustainability dynamics". Thanks to innovation, companies can advance their processes and improve their products by using more eco-friendly materials, being more efficient in their production and reducing their waste.

I4.0 represents a group of innovations that not only increase companies' efficiency, reduce costs, can beat "traditional" companies, while they can comply with the other two pillars of sustainability and maintaining high quality standards. It positively affects socio-environmental and economic externalities (El Baz et al., 2022). For instance, if, on the one hand, many job positions are disappearing, new job opportunities are being created. Advanced technologies can enhance safety and working conditions: risky and repetitive tasks are already performed by machines. According to various authors, social welfare can be improved, too. This is due to a promising growth of minimum wages due to "skill intensiveness" (El Baz et al., 2022) that would reduce economic inequality through increased global accessibility of goods and services and their affordability for production cost reduction while satisfying the demands of individual customers by offering personalized solutions (customization of goods).

These technologies and the blurring of reality and the virtual world are the true essence of I4.0. Digital automation of sustainable energy processes is among the essential factors that can by enhanced by Industry 4.0 technologies. Note that some technologies have an indirect effect on sustainability (e.g. augmented reality) (Chiarini, 2021 cited in Piccarozzi et al., 2022). Regardless of whether the influence is direct or indirect, enabling technologies pursuing the economic and environmental pillars of sustainability are Autonomous Robots, Additive Manufacturing, Cloud Computing, Autonomous Robots, Cybersecurity and Augmented Reality (Ramirez-Peña, Sánchez Sotano, Pérez-Fernandez & Batista, 2020). Other technologies that should be integrated and can contribute to the social principle of sustainability are Big Data, Blockchain, Simulation, Internet of Things and Artificial Intelligence (Piccarozzi et al., 2022). Furthermore, digital technologies offer various opportunities to improve both data availability and verifiability of supply chains sustainability claims. I4.0 enables data collection of sustainability-related data at different stages in the supply chain (carbon emissions in logistics and recyclability or reusability of discarded

products), thanks to, e.g. radio-frequency identification (RFID) (Rane & Thakker, 2019 cited in Mattheus et al., 2022).

The next section summarizes the essential challenges firms face when performing and successfully upgrading their technologies or innovating, in general.

1.2 Implementing technologies of Industry 4.0

Digitalization of companies is not always smooth since firms often have to deal with challenges and barriers, which range from those of a financial and operational nature, to those related to human beings and to strategic aspects (Marcon, Marcon, Le Dain, Ayala, Frank & Matthieu, 2019). A wide range of barriers and the importance given to them can change in various sectors/industries. Moreover, the literature has highlighted issues companies encounter in accepting and developing new technology (Lee & Xia, 2006; Rogers & Networks, 2004; Shefer & Frenkel, 2005; cited in Na, Heo, Choi, Han & Kim, 2023). Quite an obvious factor is the diverse availability of resources. As the size of companies increases, financial opportunities rises, too. Financial constraints may be a big problem for smaller companies due to their difficulties in purchasing the latest available technologies, which, in turn, would increase the gap between bigger and smaller firms. Other determinants are the maturity level of technology, which does not reach an acceptable or unified level for small and medium enterprises (SMEs), the perceived complexity of new complexity and the necessary skills and competences in using new technologies (Prause, 2019; Rogers, 1995). These would be usually uncommon in larger companies, where more specialized positions may be found. Conversely, smaller companies have the advantage of being more flexible and adaptable than larger ones (Na, Heo, Choi, Han & Kim, 2023).

Furthermore, training in using these technologies is better done in bigger companies, whereby more resources (time and money) are available and can be allocated to it. Training is different with respect to technological and financial opportunities available to firms of different sizes and industries (Boothby, Dufour & Tang, 2010). Generally speaking, big companies and small ones do not have equal opportunities in Industry 4.0 (Horváth & Szabó, 2019). Indeed, big companies have higher driving forces and lower barriers than small and medium enterprises.

In addition to the human resources barriers of necessary training to acquire competences for effectively using novel technologies, there are relevant psychological ones, too. Among them, resistance to change is quite significant and may be rooted in organizational culture. Several studies (e.g. Hansen, 1992, Jaumandreu, 2004; cited in in Lousã & Gomez, 2017) found that there is a negative relation between company size and innovation support culture (e.g., Chandler, Kellerand & Lyon, 2000; Rebelo & Gomes, 2011 cited in Lousã & Gomez, 2017). Similarly, a company's age seems to be negatively related to innovation.

2. Data and Methods

The aim of this article was to assess differences among micro, small, medium and large companies concerning their technological level. Hence, this study tested previous studies' outcomes. As such, a closed-ended questionnaire was sent by email to Slovak- and Italy-based companies. Respondents were mainly company owners and managers. The article comprises three sections, the first 2 of which were needed for the current paper's objective (Table 1), i.e. Likert scale questions to measure the technological level and classification to identify the cohort of companies according to size. It was assumed that firms of a higher technological level (i.e. more I4.0 novelties) are more sustainable than traditional ones. It was expected that bigger firms would present a higher degree of advanced technologies than smaller firms due to greater amounts of (financial) resources. More formally, based on previous studies:

H1. In the I4.0 context, there is a significant difference regarding technological levels among companies of different sizes.

To test hypothesis H1, i.e. to statistically analyze the differences of one category from another, the non-parametric Kruskal-Wallis test, was chosen, since the data were ordinal (and, therefore, not normally distributed). This test is used for the analysis of differences in cases of more than two groups (for example, company size comprising 4 groups: micro, small, medium and large firms). Because the test does not say much about where the differences lie, Bonferroni post-hoc test was used every time the Kruskal-Wallis was significant. Analyzing the Likert-like scale questions, ranging from 1 to 7 (1 = total disagreement and 7 = total agreement with a statement), it is possible to see the actual use of the specific technology. Thus, every time the mean of each question was greater than 3.5 (mean value), the particular technology was assumed to be not only installed but also regularly used by the companies of each category.

Table 1: Section of the questionnaire

Type of questions	n° questions	Examples
Sample characteristics	12 Q.	e.g. *work position, years employed, location, industry, and size of company*
Likert-like scale	28 Q.	About *personal, marketing and customer, strategic and technological innovation*
Ranking	04 Q.	About barriers to I4.0 *of strategic, organizational* and *human nature*

Source: author's elaboration based on own questionnaire.

The sample totaled 102 answers (62 from Italy and 40 from Slovakia). The entities operated in many different industries and sectors – more than 30 - grouped into two major types: manufacturing (or product) and service industries. Service industries are usually dealing with customers (final user or B2B) without manufacturing any product but delivering it. Firms belonging to product industries have to do with tangible products instead: for example, car, furniture, and heavy machinery manufacturing. In the product group (63 companies), the main companies were mechanical and electrical engineering (13) ones, followed by commercial (5) and agricultural firms (4). In the service group, more than half companies provided financial and professional services (23 over 37). Note that 2 answers were removed as not classifiable. Among the companies surveyed and compared to 2020, 37 enjoyed a better economic status, while this remained unchanged for 31 of them; finally, 34 experienced a worsening of their status. In 38 of firms, foreign investors contributed to the capital structure and just 4 companies were owned publicly or by the State. Taking into consideration the size of companies, the sample comprises: 26 micro (≤ 10 employees); 22 small (10-49 employees); 26 midsized (50-249 employees); and 28 large companies (≥250 employees).

   Work positions of respondents were grouped under 4 labels: lower managers (28), top managers (28), owners (22) and others (grouping other positions, 24). Qualification titles started from pre-university titles to post-graduated education. Respondents in possession of a post-graduate title (included PhD) were 65% of the sample. Lastly, 58% of respondents had been employed in their companies for more than 5 years.

3. Results and Discussion

Mean values for each category are reported in Table 2 (see Appendix for corresponding questions). Mean values lower or equal to 3.5 are highlighted in red. Note that as the number of employees increases (and so does the size of the firm), the score for each question related to technology becomes greater. Overall, with the exception of micro firms, all companies of the sample have adopted and used the latest technologies. Moving to technologies, it looks as if Augmented Reality and Virtual Reality technologies are not so popular among the firms studied (average score is never greater than 3.5). Interestingly, end-to-end supply chain (Q4) is fairly common among all companies, even among micro ones.

Table 2: results of the questionnaire

Firms	Q1	Q2	Q3	Q4	Q5	Q6
Micro	3.88	3.35	2.85	3.54	2.23	4.50
Small	4.86	4.00	3.23	4.00	2.41	5.73
Midsized	5.65	5.31	4.31	4.50	3.08	5.42
Large	5.54	5.36	4.54	5.18	3.50	5.86
Average for the sample	*5.00*	*4.54*	*3.76*	*4.33*	*2.83*	*5.37*
Sig. Kruskal-Wallis test	*.005*	*.000*	*.002*	*.009*	*.019*	*.025*

Source: Author's own calculation based on the questionnaire

Due to this lower score and the significant difference, compared to other firms, micro-companies were investigated further. More specifically, the industries and sectors in which each micro firm operates were studied in more detail. Most of them are involved in the financial sector. Surprisingly, most of them do not make use of Big Data, and do not have a digital vision. This would be expected from firms making bakery products, which score 1, on average, similarly to commercial companies (mean = 1). Agriculture-related firms (including farms) never scored higher than 3. The Kruskal-Wallis test confirms that there are statistical differences among groups. Therefore, the hypothesis (**H1**) should not be rejected. Further investigation to identify the differences was performed using a Bonferroni post-hoc test: for all technologies, micro firms and large companies present statistically different results. More specifically, for Q1 (digital vision), Q2 (Big Data usage) and Q3 (Artificial Intelligence), there are differences between micro and midsized firms, too. Lastly, small and large firms vary regarding their usage of big data.

The reason why these differences occur might be due to the greater financial possibilities of large companies and the sector in which these do their business. Investments are indeed key for the 4IR since, without them, the digitalization process cannot be performed. Taking advantage of I4.0 is challenging, particularly for SMEs, as this requires significant investments in technologies (Vaidya, Ambad & Bhosle, 2018; Agostini & Nosella, 2019). Moreover, when the survey was submitted, I4.0 technologies' maturity level would have been perceived as not satisfactory.

Besides these findings, related questions were about smart-working, popular after the spread of the COVID-19 pandemic. According to the respondents of firms that allowed for smart working, the pandemic experience accelerated the process towards a 'smart' company (mean = 5.55), i.e. their companies speeded up the adoption of technologies 4.0.

4. Conclusion

This paper tested the statistical difference between companies of diverse sizes. Based on the literature, it was assumed that there is a link between sustainability and I4.0, i.e. the more technologically advanced a company the more sustainable it is (beyond the scope of this paper). Being sustainable is crucial nowadays so that resources can be preserved for future generations and improve conditions for current human generations. Latest technologies of the industry shift to I4.0 can positively affect the three pillars of sustainability by providing technologies that increase safety and improve employees' working conditions, new job positions, energy savings and CO_2 emission control, increased wages and improved availability and affordability.

Implementing I4.0 in companies presents several challenges and obstacles to be surmounted, as identified in some studies in relevant literature (e.g. Marcon et al., 2019). Challenges and obstacles are of different natures, varying from operational and strategical to those of human resources. More specifically, they are related to resistance to change, financial opportunities and time to dedicate to training. The questionnaire confirmed the results of previous studies: as the size of companies increases, organizations present a higher degree of advanced technology. This may be due to various reasons, such as more investment opportunities for larger companies, propensity to risk since smaller firms tend to prefer mature technologies (again, money may be the reason) and availability of competences in using these new technologies. Moreover, micro firms appear to be so different compared to other firms scoring significantly lower than them to questions related to the technologies 4.0 they have and use.

Perhaps funds and incentives provided by the Slovak and Italian governments, as well as the European Union (European Green Deal), will not only make it digital transition easier but also reduce the gap among companies. From a management perspective, digitalization allows improved efficiency in operation and advantages in terms of lower (production) costs, and deepens customers' needs and preferences. This reflects the importance of upgrading technologies to I4.0. Moreover, tailoring strategies for implementation of I4.0 technologies centered on sustainability is also significant. The overall result of the transition will be that firms will be pursuing sustainable practices.

4.1 Limitations and future research

The study has some limitations. The statistics used cannot prove causality or absolute truth to corroborate the hypothesis due to the particular sample and the limited number of companies composing it. The geographic area may bias the results: two developed countries members of the European Union. Additional shortcomings may derive from the nature of close-ended questions as well. Such questions cannot cover all possible options (e.g. all technologies) and they are limited to providing details

about a specific topic and possible misinterpretations may not be apparent. Future research may aim at analysing the results in other countries situated in other continents. Besides, new evidence may emerge on the link between technological advancement and sustainability, as well as the factors significantly different between larger and smaller companies.

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Appendix

Questions from the questionnaire:

Q1: Your company has a digital vision clearly stating strategy and culture needed to support digital transformation.

Q2: The use of big data analysis has increased in your company in the last years.

Q3: Artificial Intelligence (AI) is extensively used in your company.

Q4: Supply chain is end-to-end planned in your company.

Q5: Augmented Reality (AR) and Virtual Reality (VR) are used by employees, among other applications, for self-learning and training.

Q6: You believe that in the immediate future new technologies will increase your company's profits.

Q7: Smart working made you and your colleagues deepen/expand your technological knowledge.

Q8: In certain ways, smart working accelerated the process towards a "smart" company.

THE IMPORTANCE OF RENEWABLES FOR ENERGY TRANSITION AND SUSTAINABLE DEVELOPMENT - LESSONS FROM THE GERMAN EXPERIENCE AND BEST PRACTICES IN INTERNATIONAL BUSINESS[1]

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Abstract
In this article the experience and best practices of German developers of renewable energy projects are reviewed. The paper also examines the history and legal framework of energy transition in Germany, thus highlighting political aspects of this process. Furthermore, renewables are viewed in the context of energy transition in Europe and as a supporting tool to the policies for sustainable development in private companies. The aim is achieved by analyzing the content of various publications on economic, environmental and climate change related topics. Additionally, a survey and case studies were conducted to obtain and synthesize empirical information.

Keywords: international business, renewable energy sources, sustainable development

JEL Classification: Q42, F23, Q01, Q48, Q56

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1. Introduction

Nowadays energy, produced by renewable energy sources (renewables), is called "green energy", because of its minimal impact on the environment and its very low levels of pollution . Furthermore, renewable energy is not only clean, but also widely available depending on natural conditions and the weather. The goal of its usage is to reduce the harmful emissions of carbon dioxide (CO_2) into the atmosphere, while minimizing the impact of the Global Warming and the Greenhouse Effect. This is also the reason why so many governments around the world have implemented numerous measures and strategies to increase the share of renewable energy sources in the total energy consumption of their countries.

The topic of renewable energy has become increasingly relevant in recent times. Through the means of its production - renewable energy sources (or renewables), it is connected to the measures of addressing climate change and related to current issues concerning energy shortage and the high prices of electricity generated for customers. The matter also concerns sustainable development and its dimensions, taking into account that the seventh of the United Nations' Sustainable Development Goals is precisely related to energy from renewables.

Germany is among world leaders in the successful implementation of green energy and its practical application. Therefore, the study could serve as an example of successful integration of renewable energy sources in international business and, at the same time, conclusions from the best German practices are able support transition to a low-carbon economy in Eastern European countries.

1.1 International business, renewable energy sources and sustainability[2]

The concept of sustainability (sustainable development is going to be used as its synonym in this paper) is a modern phenomenon influencing many areas including the international business. Through the development of sustainability policies, modern companies are gradually adapting to the changing business environment and meeting new demands of customers and partners. The renewable energy business in global aspect is no exception, and it is also implementing sustainability norms according to its three dimensions - environmental, economic, and social. Furthermore, it is important to clarify that the renewable energy is an integral part of the concept of sustainability

and is even included as a separate goal in the United Nations (UN) strategy for sustainable development, as goal number seven - "Ensure access to affordable, reliable, sustainable and modern energy for all" (United Nations, 2015).

The interconnection between international business, renewable energy sources and sustainability is, therefore, manifested through the policies of governments and transnational organizations in order to comply with the UN principles. This is mainly represented by the following two directions:

- Measures against climate change;

- Coordination and integration of policies about environmental protection, economic growth, and social interests.

1.2 The German experience in the development of renewable energy sources

At the moment, the most developed countries are investing enormous resources in order to achieve the green energy targets set for 2050. And the most developing economies are also investing in order to reduce their carbon footprint. Germany is among the leaders in terms of energy conversion and carbon reduction. The country has a long history of developing and gradually increasing the use of renewables. Moreover, there are examples of introducing technological innovations and creative measures, such as agrivoltaics and others. That is why Germany is a good example for the experience of local companies, which are working on renewable energy projects. Consequently, their experience can serve Bulgarian entrepreneurs in future work on similar projects. Therefore, the work of local project developers in Germany can serve as an example of the best practices in Europe.

Why project developers? – As their name suggests, they actually develop renewable energy projects and are the drivers for the process of creating a new power plant, which operates with green energy. Project developers are key players in energy conversion alongside governments, investors and consumers. More precisely, these companies can give us the practical insight of what are the changes in the energy sector in terms of renewables. Most German project developers from Saarland are operating on international level and, therefore, involved in international business.

2. Data and Methods

This article is the result of years of research from two separate university projects and two different universities - one in Bulgaria and the other in Germany. The former mainly relates to the sustainability policies of companies with Bulgarian and international presence, and the latter relates to the impact factors of renewable energies in international business based on the example of German project developer companies.

In this case, some of the findings on these two topics are briefly presented, but the completed results will be published in greater detail in the near future.

The methodology includes analysis and synthesis of empirical information and databases from German companies, but also content analysis of various publications on economic, political, environmental, and ecological topics. Real-life business examples and case studies, relying on the best practices in the research area, are used. The experience, and knowledge of German project developers (from Saarland) are essential. Solar PV panels and onshore wind plants are the most suitable sources because they have the greatest potential for further development in Bulgaria as affordable and cost-efficient. Furthermore, the included interviews are conducted with scientists and policy makers, and the sources used are from project developers and the results of a questionnaire.

The author aims to explore success factors of renewables as well as their impacts on international business level. The timeframe of the analysis is from 2000 to 2021, but also taking into account what the goals and expectations are for the development of the energy sector up to 2030. Additionally, a custom methodology has been developed in order to analyze the sustainability practices of selected international corporations.

3. Results and Discussion

We will start with some interesting findings from the research about sustainability (Dimitrov et al., 2021). They are presented in the following figure, which uses data from a specially developed rating system, created by the author in order to evaluate the sustainability policies of the companies under review:

The main criteria by which companies are included in the rating is that they are large enterprises with a proven track record of good sustainability practices and that have operations in many countries. The selected companies are among those with a well-developed sustainability policy and should be an example to others. Furthermore, each of the five companies has an impact on the energy market and is directly or indirectly linked to renewable energy or its rivals (fossil or nuclear energy).

We can summarize the information by pointing out that Monbat JSC and Bader GmbH & Co. KG are at similar level in regard of the sustainability policy applied by their managers and have an average score of 4.58. Dietsmann is last of the top five companies because of the nature of work and low score in green energy evalutaion. This is normal as the company is mainly involved in the maintenance of power plants operating with fossil or nuclear energy. There is place for changes in the future, when Dietsmann's management can focus on renewable energy projects. Aurubis AG, on the other hand, is an example of a successful company using innovative sustainable business models and production practices, despite being involved in heavy industry and the processing of metals and raw materials. Top performer in the applied ranking

is Mondelez International, which, due to its pursuit of ever higher sustainability and a plan for future development, receives a score of 4.92 out of 5. It should be noted that the analysis is focused on measurements such as environmental responsibility (such as recycling), social impact (such as labor practices and inclusion of workers), corporate governance (such as transparency and reporting) and innovation technology (such as new methods of production). This information is included in the full text of the research, on which this article is based on.

Figure 1. Ranking companies according to their sustainability policy implementation level
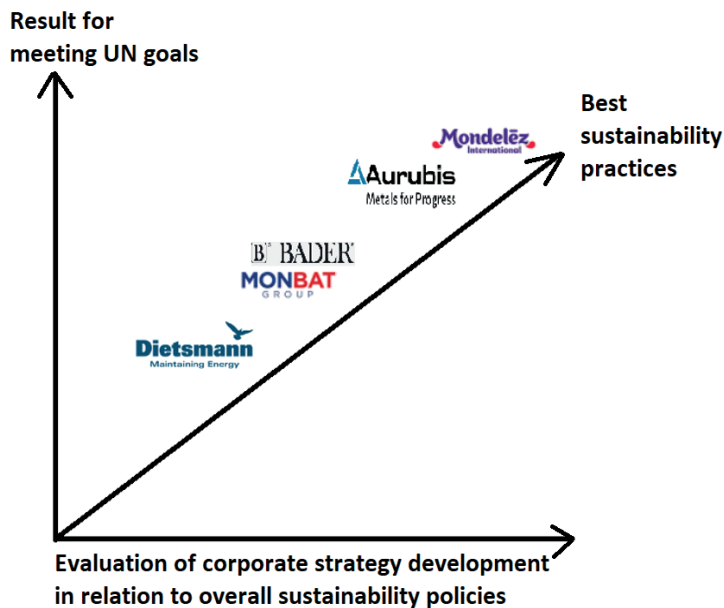
Source: Own representation based on sustainability reports of the selected companies and author's evaluation model

Other data from a project (Dimitrov, 2022) that includes a detailed analysis of the German energy transition and the best practices of German project developers (mainly working with solar and onshore wind projects in the Saarland region, but with influence in neighboring markets). The research was divided into a theoretical and a practical part.

The German energy transition (Energiewende) is an ongoing process and is still directed by the political will and actions. In fact, according to a study (Evans, 2016), the term Energiewende was introduced back in the 70s as part of the anti-nuclear

movement but it It gained popularity around year 2000 due the effects of Global Warming. German legislation about the energy sector started to change in 1990. The Electricity Feed Act of December 7, 1990 (StromEinspG) was introduced in the country from the beginning of 1991. Almost a decade later, the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz or EEG, 2000) was accepted as a new step in the promotion of renewable energy sources in Germany. The whole process of the German energy transition could be represented as follows:

Figure 2. Simplified timeline for the process of energy transition in Germany
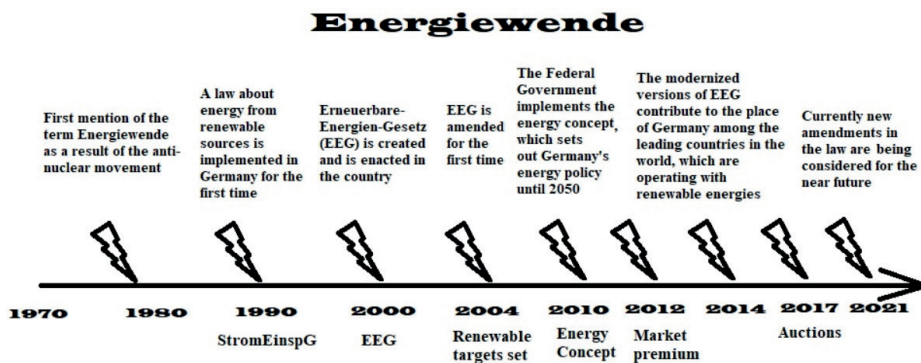
Source: Evans (2016) and Bundesministerium für Wirtschaft und Klimaschutz (BMWK)

It was very important to understand the legal and theoretical background of the energy transition in Germany, including the history and recent changes in EEG. However, the project is mainly practice-oriented, more attention is devoted to the second part of the research with empirical analysis.

As a next step, a special questionnaire was created for gathering practical information. It was sent to several companies, which are the most significant project developers in Saarland. They specialize in carrying out projects with a focus on solar and onshore wind installations. These operate not only locally but also internationally, therefore, especially suitable for the current research purposes.

The completely anonymous questionnaire included twenty questions. The aim of the survey was to identify best practices in the work and development of renewable energy projects in Germany and to support future implementation of such practices in Eastern Europe. Another goal was to find out expert opinions on what new strategies and incentives should be promoted by policy makers to further encourage successful implementation of renewable energy projects. The third key was to increase

the awareness of the society about the actual working activities of project developer companies in order to encourage further adoption of energy from renewable sources.

Based on the answers from the questionnaire, we were able to construct a profile of the average manager in a renewable energy project development company in Germany. The typical manager in such company could be described as:

- Usually, male over 50 years of age (60% are over 50 and 80% older than 35);

- He has more than ten years of experience in the energy sector;

- He runs a company that has several local and international competitors (usually less than ten);

- Some of the numbers are not decisive, but it is noteworthy that nearly 40% of managers run large companies with more than a hundred employees. The rest of the companies (60%) have less than twenty workers.

For the project developers in Saarland, the most common problems are related to the long time needed for obtaining the permits for launching a project, as well as restrictions regarding the local environment. All respondents claimed these two issues as top problems for resolution.

At the end of the questionnaire, the German managers of renewable energy project development companies made suggestions to their Bulgarian counterparts. Those recommendations includes aiming for more transparency in administrative and operational aspects, as well as paying attention to the remuneration of their employees, which is the key to successful business. The topic of workers' skills and proportionate remuneration is increasingly discussed in Eastern Europe, especially since energy prices and inflation are rising. In Bulgaria, many workers will also need to be properly qualified to work with renewables, as currently a significant part of the population still works with conventional energy sources.

Subsequently, some of these companies also sent case studies for analysis. The case studies pointed out the exact types of problems managers in Saarland face while they are involved in an onshore solar or wind renewable energy project. Then the impact of the issues was measured based on the formulated factor groups. From this information, which was provided by the local project developers in Saarland we can draw conclusions about general problems their colleagues across Germany. Therefore, we can assume that German project developers present practical guidelines for solving problems in their operations that may be useful for their Bulgarian colleagues in the future. There were four case studies, which were sent by the companies and here is the summary:

Table 1. Findings from the case studies

Case study	Type of energy for the project	Type of problem	Impact factor	Type of Solution
1	Solar	Legal issues and need for extended credit line	Law and Politics	Intervention by the state authorities
2	Wind	Problem with the delivery of the wind turbine	Economy and Management	Intervention by the state authorities
3	Solar	Problem with the beginning of the construction work due to ancient remains in the area	Law and Environment	Adjustment the construction plan and decision of the Management
4	Solar	Problem for the safety of workers and locals	Others (force majeure)	Increase in spending and changes in time planning

Source: Information from the cases studies and project developers in Saarland

The information collected from all case studies shows the expertise of project developers in Saarland from their daily business. This confirms that companies in Germany have the know-how in dealing with problems of various kinds – from local regulations and restrictions to defusing bombs and clearing sites for new projects. We should know that all conclusions are based on the information from local companies. Across the county are noted other problems such as grid integration and connectivity, resistance of farmers to the usage of agricultural land for energy purposes, storage issues and lack of stable supply of energy depending on weather conditions. Each issue requires different approaches and solutions.

From the beginning of the century project developers in Germany had the time to adapt to market and regulatory changes. Their colleagues in Bulgaria have relatively less experience in working with renewable energy sources than their colleagues in Germany. Therefore, it is important to understand and learn from lessons of the past.

The role of government and scientific institutes in the energy transition in Germany was evaluated through four interviews with scientists and policy makers who are specialized in working, researching, and direct involvement in policies about green energy. The information is summarized as follows:

Figure 3. Key drivers for the German Energiewende
(summary from interviews with the experts)
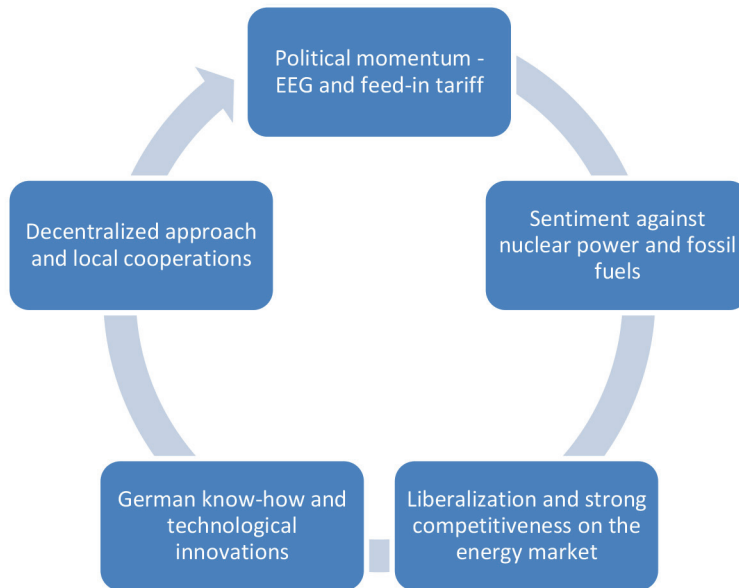
Source: Interviews with different experts and policy makers

Those conversations were very helpful in order to understand the current sentiment and upcoming trends in Germany regarding the development of renewable energy sources. Furthermore, it gave us the opportunity to highlight measures supporting smooth energy transition towards renewables and to summarize key drivers for German energy transition (Energiewende). Interviews and various opinions of experts revealed the key drivers (five factors from the figure) for the energy transformation process in Germany.

Regular updates in the legal framework, decentralization and liberalization contribute for the rise of renewables more than pure financial incentives. Technological innovations, awareness of society and political will to implement the necessary changes also contribute in achieving secure, cleaner and energy efficient future for next generations.

4. Conclusion

The information provides a basis for predicting future trends in sustainability policies and renewable energy development. The following conclusions could be pointed out:

- The international business with renewable energy sources is part of a global system and is susceptible to various changes in the economic or political environment. Renewable use is increasing mostly due to government policies and incentives, also in times of crisis and rising inflation;

- Private investors are looking to profit from renewables, but governments see them as a measure to reduce the effects of the Global Warming phenomenon and to provide energy security; in other words, RES implementation is important for all;

- Investing in renewables can help companies is able to reduce the uncertainty of price changes in volatile market conditions, but also ensure a cleaner and safer future for next generations;

- Renewable energy will have a significant impact on global economy in the near future, especially after the recent events. The long-term forecast is that renewables will be the world's leading energy source by the middle of 21st century.

Currently, there are also conditions for an increase in global energy prices. Among the leading reasons are rising inflation, supply chain problems, rising tensions around the Globe, lack of reserves of different commodities and others. In parallel, energy needs of the population have also increased, which is a further prerequisite for the impending energy crisis. Therefore, the construction of a greater number of renewable energy generation facilities is a must, as green energy is cheaper and has a very low environmental footprint.

The following suggestions can facilitate energy transition and help in solving energy issues:

- Less bureaucracy will be a powerful incentive for investors and more entrepreneurs to enter the energy business;

- More renewable energy professionals are needed as the number of installations is expected to increase and create new jobs worldwide;

- More funding is needed for scientists, specialized in the study of renewable energy applications of all kinds. This could help improve the current level of technology and increase the efficiency of installations. The lack of funds occurs also in research into energy systems, capable of interconnection between renewable energies, flexibility options and convergence of associated electricity, heating and transport infrastructure;

- Implementation of independent courses in schools and universities will support awareness and general knowledge of the population concerning the benefits of renewables.

Following this analysis, we can reasonably predict that the use of renewables will continue to rise in the coming years. This will not only change economic balance but will also provide a stimulus for international companies to deal with the consequences of current market changes.

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Book Review

Rethinking Public Choice

by Richard E. Wagner,
Emeritus Professor of Economics, George Mason University, USA.
Edward Elgar Publishing, 2022, p.p. 192
ISBN: 978 1 80220 473 5

reviewed by Brendan Kennelly[1]

Rethinking Public Choice is the third book in a series of books under the rubric "Rethinking Economics" published by Edward Elgar. According to the publisher's web site, the series is a forum for innovative scholarly writing from across all substantive fields of economics. The series aims to enrich the study of the discipline by promoting a cutting-edge approach to economic thought and analysis. As somebodyανέν who studied public choice many years ago with, among others, Dennis Mueller and Mancur Olson, I read the book hoping for intellectual stimulation and new insights on how the public choice field should develop.

The book begins with a short preface which outlines the objective of the book. Professor Wagner states that he wants to widen the analytical purvey to which public choice pertains. Wagner uses the term 'additive political economy' to refer to what most people would think of if asked to define public choice, namely that it is the application of economic concepts to political behaviour. His book argues that an alternative or complementary approach should also be considered. This approach he terms 'entangled political economy'. Throughout my reading of the book I struggled to find a succinct statement informing the reader what exactly entangled political economy refers to. For example, a web site that Wagner refers to a couple of times (https://www.entangledpoliticaleconomy.org/about-entangled-political-economy) states that **"**Entangled political economy is a research framework developed by Richard E. Wagner to advance the understanding of social coordination and to restore economics as a study of society (as opposed to a study of markets). It views individuals, and the private and public sectors, as being intertwined in overlapping exchange relationships along competitive and collaborative dimensions." I wish the book under review had begun with a clear statement like this one.

The book consists of twelve chapters. They are generally short, eight for example contain between eleven and thirteen pages. Unfortunately, the book does not contain

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an introduction which might have explained the contribution of each chapter in developing the overall thesis of the book. Each chapter has an introductory section but only rarely does this section inform the reader what the goal of the chapter is and how the argument of the chapter will be developed in successive sections. The reader is left to wonder what the purpose of each chapter and each section within a chapter is.

The title of the first chapter – Public choice as the economics of politics: its postwar origin - suggests that the reader could anticipate a history-of-thought-type review of how public choice, or at least the version that Wagner calls additive political economy, developed. That is how the chapter begins. But after three pages, the chapter takes a somewhat strange turn and becomes a rather idiosyncratic collection of short sections that could collectively be called 'things that Richard Wagner thinks about'. The sections on issues such as Two Objects for Economic Inquiry, Property Rights in Relation to Economizing Action, and Economic Science between Hume and Pareto are often interesting but their relationship to the stated objective of the book is often tenuous. Unfortunately, a problem that recurs throughout the book – poor editing – is already apparent in the first chapter. On page 11, Wagner states that Pareto began his working life as an engineer. He repeats the point on the following page. Just in case we have forgotten the point, Wagner repeats it in Chapter 12 on page 132. The last section in Chapter 1 – Additive vs. Entangled Political Economy – did not provide a satisfactory definition of Entangled Political Economy. When reading the book for the first time I felt that this might have been an opportunity missed and so it proved.

Chapters 2 and 3 should be read together because they cover similar ground which could broadly be described as methodology. It is a great pity that no editor read these chapters together because he or she would have noted that there are several sentences and in some cases whole paragraphs repeated in Chapter 3 having already appeared in Chapter 2. I counted six examples of this. Chapter 2 refers to various writings by people such as Frank Knight, Vincent Ostrom and Warren Weaver all of which could be said to have in some way provided part of the methodological framework that distinguishes Entangled Political Economy from Additive Political Economy.

Chapter 3 is entitled Thinking with models: an inescapable conundrum. After a relevant opening section, the author digresses to a section headed 'Where lies equality within theories of exchange and human association?' This section contains an interpretation of the Edgeworth-Box analysis of trade that I doubt many readers would accept. Wagner claims that "it is common to treat exchange as an activity that occurs between equally situated persons" (p. 29) and that "the Edgeworth model has been widely interpreted as showing primitive exchange among equals that goes awry in the direction of inequality through growing social organization" (p. 31). The words 'common' and 'widely' are doing a lot of work in these sentences, work that I do not think is warranted. The chapter continues in this vein with several odd observations thrown in. On page 32 for example, people are described as descending or springing

from a mother's womb *three* times in a single paragraph. A good editor, even an aver-age one, might have advised against using the word 'surely' four times in the same paragraph. Later, on page 37, a sentence most of which is identical to a sentence that appeared on page 21 ends with the words 'giving substantive referents'. These three words are then repeated leaving me to wonder if anybody checked the proofs of this manuscript before it went to print.

Chapter 4 covers concepts and categories. A paragraph on page 44 outlines some ideas about how societies should be analysed as networks of individuals. But the reader has been told this already – the paragraph on page 44 is identical to what was stated only two pages earlier. Wagner contrasts equilibrium theories and theories of social organization. The former are characterized by optimization, the latter by spon-taneous order. Additive political economy is in the first category, entangled political economy in the second. Additive political economy analyses the world on the basis that politics is separate from economics. Page 50: "by contrast [to additive political economy] entangled political economy treats economy and polity as mixed together and separable only as an abstract but not as a practical manner." Is that a reasonable statement about additive political economy? About, for example, Olson's theory of interest groups or the Krueger/Tollison/Tullock theories of rent seeking?

The pattern of including sections that may be interesting in themselves but have at best a tenuous relationship with the subject matter of the book continues. The final section of Chapter 4, Is Democracy Feudalistic?, opens with the following sentence: "It is surely reasonable to expect a reader to wonder what I can possibly mean by ask-ing whether democratic governments are feudalistic." An alternative opening might have been to ask if a reader was wondering why the question was being asked at all.

The opening page of Chapter 5, entitled Simple stipulation vs. complex emergence as modes of inquiry, includes the following statement on page 59: "Within the Marx-ist orientation, which seems perhaps dominant among contemporary economists, or at least surely among macro theorists …". Maybe contemporary macro theorists are very different than when I studied macro thirty years ago. Maybe. The chapter in-cludes some interesting insights into the different approaches taken by James Bu-chanan and Gordon Tullock. Wagner outlines at some length the differences between political and social organizations. This is one of the better chapters in the book.

I mentioned earlier that the book did not contain an outline of the structure of the book. Likewise, many individual chapters do not include an opening line or two letting the reader know what the chapter will cover. Halfway through my reading of the book I thought of one plausible reason for their absence. The book is not really a book in the sense that there is some logical structure to the argument and to how the various chapters contribute to the development of that argument. Instead, the book is best regarded as a series of short essays. For example, Chapter 6, entitled Parasitical tectonics within entangled systems of political economy, contains an opening section

and six entitled sections. The opening section and the next two sections have some logical coherence but the remaining sections could have been in many of the preceding or following chapters. This haphazard structure explains the recurring issue of repetition in the book. Any writer who combines around seventy separate essays into a single book would need to be very lucky to avoid repetition especially if they do not have a good editor. The final section of Chapter 6, for example, contains material that is already included in the opening section of the same chapter. The chapter contains an interesting section on Maffeo Pantaleoni's work and some useful remarks on the differences between market and political exchange.

The first entitled section of chapter 7, The peculiar language of the public policy shell game, does indeed address the question of whether it is useful and reasonable to analyse public policy as a shell game (by which Wagner means that public policy phenomena are misnamed in order to hoodwink people into thinking that they are something that they are not.) There is more coherence in this chapter than the preceding ones. Some of the material is rather bizarre. Take the following passage from pages 92 and 93:

"Systems thinking differs significantly from standard economic thinking. Within standard economic thinking, system properties are treated as objects directly subject to someone's choice. For instance, whether a minimum wage will be established at $15 an hour is a choice that someone can make or not. Within a systems orientation, by contrast, a minimum wage is an output of some legislative system, and an output from a system is categorically different from someone's choice. Orthodox economics treats an economic system as a field akin to a gravitational field. For instance, water that enters a lake at one point will be quickly distributed throughout the lake to maintain the height of water at the same level throughout the lake."

I know it is cumbersome to include references to every argument made in any book but I wish Professor Wagner had told us who in standard economics has regarded the issue of setting the minimum wage as a choice that someone can make. I don't think he could have given a reference because I have never heard of anybody saying that. As for the statement in the passage about water entering a lake I have no idea what that was meant to convey.

Chapter 8, The multiple faces of federal government, is the best chapter yet as regards coherence. Wagner maintains the focus on federalism throughout. The chapter contains an interesting discussion about the possible relationship between federal structures of government and citizens' liberty. The issue of whether federal systems can or should be analysed as promoting competition as economists analyse competition in markets is explored. I enjoyed the following line on page 108: "*One of life's man ironies is that the concept of competition as developed by economists over two or so centuries has managed to abolish any semblance of competition*."

The pattern of chapters being more focused continues with Chapter 9 entitled Bureaucracy and the economic organization of political enterprise. It helps that the second sentence in this chapter states what the chapter will do: "This chapter explores some of those differences [between political and commercial enterprises] and examines their possible consequences" (p. 114). A couple of statements in this chapter left me wondering if the book is better regarded as 'rethinking economics" instead of "rethinking public choice". On page 118, he refers to his "desire to treat economics as a social science and not a science of rational choice." On page 123, he writes that "An economy is necessarily and unavoidably an ecology of plans. More than anything in this book, I am seeking to develop schemes and modes of thought that illustrate the operation of such concepts as emergence and invisible hands."

The section, Cities, capitalization and ownership, invites readers to think about cities as municipal corporations with an ownership structure that could in principle be similar to the ownership structure of commercial enterprises. He describes taxes as "parasitical attachments to market transactions" (p. 123). There is no room for notions of citizenship or solidarity in this analysis, at least none that might find expression outside of possible private actions. The chapter ends with a comparison of two approaches to the study of bureaucracy: Niskanen's theory which Wagner describes as featuring an outside-in perspective and Turlock's theory which he says features an 'inside-out' perspective.

Chapter 10 is entitled What do central banks do within an entangled system of political economy? Unfortunately, the emerging pattern of more coherence within chapters does not last. There is very little about central banking in the chapter. The first named section, Reason, Rationalization and Central Banking, has some interesting observations on reasoning and rationalization but nothing at all about central banking. The section could have appeared in most of the previous chapters. On pages 134/5, he writes that "With respect to market environments, those environments are much more interactionist and conversational than standard economic theory leads an observer to think." These kinds of observations are interesting. What they are doing in a chapter on central banking is a mystery. When I finished reading the chapter I recalled a line from the beginning of the chapter. It states "What I want to explore in this chapter is perhaps better conveyed with a title like: "Does the human ability to rationalize anything under the banner of rationality promote a socially generated form of deception through the promotion of false or fake forms of discourse?". That indeed would have been a better and more accurate title.

The opening section of the penultimate chapter, Public choice, redistribution, and the relevance of the "Social Question", indicates what the rest of the chapter will address. However, once again, the indication is not borne out by the rest of the chapter. The chapter includes, *inter alia*, a section on Thomas Szasz's book, The Myth of Mental Illness, Wagner's thoughts on the paper by George Stigler and Gary Becker,

De Gustibus not est Disputandum and a section with the intriguing subtitle, Spartacus Revisited. That particular section includes the following claim: "We have placed ourselves at the right hand of God the Creator and treat this position as granting us special dispensation to eat of the fruit of the tree of knowledge, even though we were warned against doing that and were ejected from Eden from having done so." This claim is presented as part of his argument that public discourse regarding redistribution is in an appalling and atrocious state. I cannot decide whether the claim is based on one of Wagner's own theological convictions or is it based on his belief that people who believe in God are particularly susceptible to having stupid ideas as regards redistribution.

Chapter 12, the final chapter, begins with an opening section where Wagner does tell the reader what he plans to do in the chapter. He states that he "shall present six brief descriptions of the contributions to constitutional political economy of six significant thinkers". The brief descriptions of people such as James Buchanan, Gordon Tullock and Knut Wicksell, are somewhat interesting although far too brief to contain many original insights. The bigger question though is what these descriptions are doing in the final chapter of this or indeed any book. The descriptions come across as though Wagner learned that he was a few pages short of a full manuscript and needed to add in a few extra pages at short notice. The absence of an editor is apparent all the way to the end. His description of Tullock contains a paragraph on Buchanan. Why did he not put that in the description of Buchanan on the previous page? The book ends with a description of Walter Eucken. No attempt is made to summarise the main thesis of the book or to indicate possible future developments of same.

Before giving my final assessment on the book I would like to return to the issue of editing. On their web site, Edward Elgar state that *"We will copy edit the text and code the manuscript files for typesetting. .. The copy editing will be undertaken by one of our freelance copy editors, under the desk editor's guidance; and the complete manuscript will be read through carefully for clarity and consistency and coded for typesetting. The grammar and spelling will be checked and the references cross-checked. Please note that our copy editors are not necessarily experts in the subject area of your book and so, while they can improve grammar, the original meaning needs to be clear."*

For some reason, there was a breakdown in the editing process for this book. It is striking that Professor Wagner does not thank any editor for helping him with the book. Basic spelling and grammatical errors, overuse of words such as 'surely' and phrases such as 'it is evident', frequent reference to himself in the third person, and needless repetition of whole sentences, are all issues that should have been resolved before the book was published. Edward Elgar have published 4,716 economics books and has another 111 waiting to be published. After finishing this book, I am left wondering if the publisher has sacrificed quality for the sake of quantity.

Overall, the book was a major disappointment for me. I don't think the author made it sufficiently clear how the various arguments he put forward amounted to a re-thinking of public choice. Indeed, as mentioned already, some of the most interesting sections of the book seemed to me to be more relevant to economics in general than to public choice in particular. Wagner has in fact published a second book in the same series with the title Rethinking Economics as Social Theory. I will leave it to more dedicated readers to discover how much overlap there is between the two books. After I finished reading the book under review, I found a paper that Wagner published in 2014 entitled Entangled Political Economy: A Keynote Address. I recommend that anybody interested in this topic read that paper instead of this book.

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