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THE RELATIONSHIP BETWEEN ECO-INNOVATION AND EUROPEAN COMPANY SUCCESS - THE DRIVING FORCES

Master thesis, 2023
Master of Science in Business Administration
University of Stavanger Business School
Specialization: Business Development and Innovation

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Abstract

This research examined how eco-innovation drives European enterprises' financial performance. The Panel Least Square Model was used to analyse a 2014–2020 dataset from 11 European nations. Policymakers, industry practitioners, and researchers can benefit from the study's eco-innovation insights. Eco-innovation was favorably connected with energy usage or CO2 (Carbon dioxide) footprint reduction, pollution reduction, product recycling, and product life extension. However, these relationships were not statistically significant, suggesting that they may drive eco-innovation but not alone. Eco-innovation and financial success were also examined. The coefficient showed that eco-innovation improved financial performance. This link was not statistically significant. Eco-innovation's influence on financial success may rely on elements not included in this study. The study's findings support innovation theory's multifaceted and interactive character. The shift from a linear to an interactive model of eco-innovation emphasizes the relevance of various elements and their interaction in generating eco-innovation results. According to the findings, governments should encourage collaboration between companies, academic institutions, and government agencies to share information and spread innovation. Create platforms and networks for eco-innovation best practices, technology, and knowledge. Open innovation and collaborations boost eco-innovations across industries.

Keywords: *Innovation, Eco-innovation, Financial Performance, Internal Research and Development (R&D), Environmental Benefits, and Public Performance*

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CHAPTER ONE

1. Introduction

Eco-innovation promotes a company's sustainable development and performance, attracting academics and businesspeople (Holger et al., 2022). Businesses seek competitive advantages to improve performance in a world plagued by resource shortages, environmental degradation, and pollution (Cai & Li, 2018). Ecological innovation, or eco-innovation, may help firms grow sustainably while improving performance. To be environmentally responsible and sustainable, companies must use organizational, procedural, and product eco-innovation strategies (Hojnik & Ruzzier, 2015).

1.1 Background to the Study

Kemp and Pearson (2007) define eco-innovation as the development, assimilation, or exploitation of a good, service, or management or business method that is novel for the organization (creating or adopting it) and that, over its life cycle, reduces environmental risk, pollution, and other adverse effects of resource use, including energy, compared to other relevant alternatives.

Lin et al. (2014) researched eco-innovation in Western and Southern European countries and, more recently in Far Eastern countries including India, China, South Korea, and Malaysia. Businesses and communities need it, and research in this field has generally increased. Environmental degradation is also threatening human life. Eeco-innovation has helped many towns protect the environment and grow economically. Fliaster and Kolloch (2017) say economic profitability and environmental sustainability are crucial.

Due to customer knowledge of environmental challenges and the need for sustainable products and services, corporations have added environmental advantages to their offerings. Firms emphasize environmental advantages to attract eco-conscious consumers, obtain a competitive edge, and improve financial performance (Hojnik & Ruzzier, 2016). In many sectors, different sorts of businesses face distinct dynamics and obstacles. Market rivalry, technology advances, customer tastes, and regulatory frameworks differ among industries and can greatly impact a firm's financial success (Holger et al., 2022). Companies may match R&D investments to industry demands by evaluating the relationship between turnover by type of organization, R&D financing, and financial success. Alignment can boost product differentiation, market share, operational efficiency, and financial success (Cai & Li, 2018). Businesses are realizing the necessity of eco-innovation, which involves creating and using ecologically friendly goods, services, and processes (Triguero et al., 2013). Eco-innovation helps businesses reduce their environmental effects. Sustainable product design, production, and supply chain management may help companies decrease their environmental impact. To evaluate eco-innovation strategies' sustainability, turnover by innovation, R&D investment, and performance must be understood (Hrabynskyi et al., 2017).

Human capital—particularly staff education—shapes a firm's skills and competitiveness. Human capital—employees' skills, knowledge, and expertise—drives a company's capacities and competitiveness. University-educated workers contribute specialized knowledge and analytical abilities that may boost innovation, problem-solving, and value generation. Governments subsidize R&D to boost corporate innovation and technology. This study examines the relationship between R&D spending and university-educated staff to determine how knowledge-intensive skills affect business financial performance. Publicly funded R&D and highly educated workers help enterprises use knowledge-intensive skills and boost financial outcomes (Triguero, Moreno-Mondéjar, María & Davia, 2013). Innovative and high-performing companies value staff education. Higher education levels, critical thinking abilities, and specialized experience can help a company develop innovative goods, services, and processes (Hrabynskyi, Horin & Ukrayinets, 2017).

High-educated workers contribute important information, expertise, and abilities to an organization. University graduates can think critically, solve complicated issues, and innovate. These personnel may promote eco-innovation by inventing environmentally friendly technology, applying green practices, and supporting sustainable behaviors inside the organization (Matuzevičiūtė & Mačiulytė-Šniukienė, 2018). Consumers like green products and services. Consumers are increasingly contemplating the environmental effect of their purchases and seeking solutions with actual environmental advantages. Butkus, Mačiulytė-Šniukienė, Matuzevičiūtė, & Cibulskienė 2019). Public R&D funds innovative initiatives, particularly environmental sustainability ones. Green technology, renewable energy systems, and sustainable manufacturing processes are developed and implemented using this support. The relevance of environmental benefits and R&D financing allows for an analysis of how financial resources might be channeled towards environmental performance efforts (Mačiulytė-Šniukienė & Sekhniashvili, 2021).

1.2 Statement of the Problem

Due to its potential to promote sustainable development and boost company performance, eco-innovation—the creation and use of environmentally friendly goods, services, and processes—has received interest from academics and industry. Given resource scarcity, environmental degradation, and pollution, environmental advantages in corporate operations are becoming more important. In this scenario, organizations aggressively seek competitive advantages and performance improvements (Costantini et al., 2017). Previous studies have examined eco-innovation in certain situations and nations, but there is a need to evaluate how environmental advantages and R&D financing affect financial success. Understanding how corporations prioritize environmental advantages and use public money for R&D to foster eco-innovation might help improve sustainability and environmental performance (Butkus et al., 2019).

Human capital—particularly employee education—drives innovation and corporate performance, according to prior studies. Higher-educated workers contribute to eco-innovation with their expertise, critical thinking, and analysis. This study examines how knowledge-intensive skills drive eco-innovation and environmental sustainability by examining the effect of R&D investment and university education on financial success (Horbach, 2016). To determine if eco-innovation methods can achieve sustainability goals, the research problem must be addressed and the relationship between environmental advantages, R&D funding, and financial success examined. This study can help firms, governments, and stakeholders understand how environmental concerns, public financing for R&D, and human capital drive sustainable practices and financial success.

1.3 Aim & Objectives of the Study

This study aims to examine how eco-innovation drivers affect European enterprises' financial performance. The study examines the following relationships:

i. The study examines these determinants and eco-innovation results to reveal firm-level eco-innovation drivers.

ii. The study examines if eco-innovation improves financial success in organizations.

1.4 Research Questions

i. How do innovation drivers impact eco-innovation?

ii. How does eco-innovation affect business performance?

1.5 Hypothesis of the Study

H01: European corporate eco-innovation and drivers are unrelated.

H02: Eco-innovation doesn't affect European businesses' financial performance.

1.6 Rationale of the Study

Sustainable development and ethical business practices in Europe need to understand eco-innovation drivers and their effects on firm performance. Turnover by innovation, the percentage of employees with university degrees, the importance of environmental benefits from consumption, turnover by type of enterprise, and public funding for R&D can significantly impact firm financial performance. The study investigates these connections to understand how these determinants impact business performance. Businesses, politicians, and other stakeholders may learn eco-innovation and financial performance methods from the findings. This knowledge may inform decision-making, resource allocation, and policymaking to support sustainable business and environmental protection in Europe. The study helps explain eco-innovation, business performance, and driving variables in Europe.

1.7 Delimitation of the Study

European companies are studied. Since eco-innovation drivers and their effects on business performance vary by location and country, the findings and conclusions may not apply to other firms. The research spans 2014–2020. The analysis only covers this period and may not reflect long-term patterns or changes. The study uses public datasets and data sources. Data availability and quality may restrict study results. Panel Least Square Model econometrics are used in the investigation. This method works well with panel data, but its assumptions and constraints may affect its accuracy and generalizability. The research examines eco-innovation drivers such as lowering energy consumption or CO_2 footprint, pollution, product recycling, and product life. Due to data shortages, the research does not explicitly address additional eco-innovation drivers or variables.

CHAPTER TWO

2. Literature Review

2.1 Conceptual Framework

2.1.1 Innovation Theory: From Linear to An Interactive Model

Innovation theory evolved from linear to interactive. Innovation is a linear process with discrete phases from research and development through commercialization, according to the linear model (Utterback & Abernathy, 1975). This paradigm believes innovation begins with fundamental research, then applied research, development, and manufacturing, then marketing and sales (Freeman & Soete, 1997). This linear model has been criticized for simplifying invention, which is complicated and interactive (Chesbrough, 2018). The interactive model of invention has resulted. The interactive model of innovation emphasizes collaboration and interaction between actors (Laursen & Salter, 2018). This approach recognizes that innovation is a complex, dynamic process including enterprises, universities, research institutes, and government agencies (Lhuillery & Pfister, 2019). The interactive model emphasizes feedback loops and learning to help actors improve their inventions over time (Chesbrough, 2019). Innovation is co-created in the interactive approach. Open innovation, where players share information and ideas, is also stressed in this paradigm (Bianchi & Cavaliere, 2021). The interactive model of invention is more collaborative and dynamic than the classic linear model. This paradigm recognizes that innovation comes from interactions and partnerships among innovation ecosystem players, not merely research and development.

Innovation is multifaceted. Innovation across sectors and industries has been a priority in recent years. Innovation boosts economic growth, competitiveness, and sustainability (Chesbrough, 2019). Innovation is inventing and executing new ideas, goods, services, or business models that provide value. It entails implementing new methods, technologies, or practices to enhance, differentiate, and streamline organizations (Damanpour, 2014). Technological, process, product, organizational, and business model innovations exist (OECD, 2021).

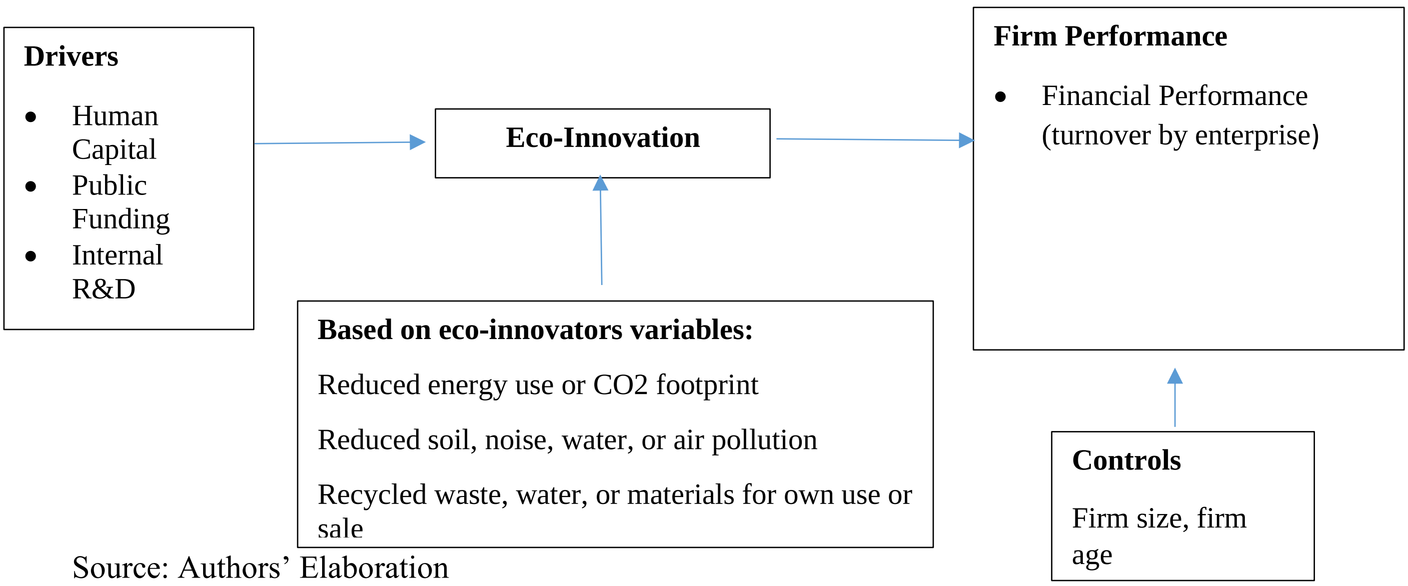
Technological innovation involves creating and using new or existing technologies to produce value (Dahlander & Gann, 2020). Process innovation improves efficiency, productivity, and quality by changing manufacturing or operational processes (Dodgson, Gann & Phillips, 2019). Product innovation addresses changing client wants and preferences (Edquist & Zabala-Iturriagagoitia, 2020). Organizational innovation involves changing management practices, structures, or arrangements to improve performance, cooperation, and flexibility (Fagerberg, Fosaas & Sapprasert, 2019). Finally, business model innovation entails rethinking and reworking the core logic and structure of an organization to offer new value propositions, income streams, and competitive advantages (Garcia & Calantone, 2019).

Technology, market dynamics, competitive forces, regulatory frameworks, and organizational competencies promote innovation. Organizations that promote innovation, encourage experimentation, and give resources and assistance for idea formulation and execution are more likely to succeed (OECD, 2021). In conclusion, innovation is the discovery and execution of new ideas, products, services, or business models that create value and maintain economic growth. Innovation includes technological, process, product, organizational, and business model advancements. Today's dynamic and competitive climate favors innovative and supportive organizations.

2.1.2 Eco-Innovation

Eco-innovation involves creating and implementing environmentally friendly goods, processes, and services. It entails developing innovative, sustainable solutions to environmental issues and promoting a circular economy (Pansera, Grønning & Omta, 2021). Eco-innovation aims to transform production and consumption habits systemically. It seeks environmental integration research, development, marketing, and use. Kirchherr, Reike, and Hekkert (2018) define eco-innovation as designing and implementing innovative goods, processes, and services that decrease environmental impact and help transition to a sustainable economy. Their examination of 114 circular economy definitions illuminates eco-innovation and environmental sustainability. Eco-innovation can include the creation of greener technology, products, industrial methods, circular economies, and business strategies. It includes product and service extraction, manufacturing, distribution, usage, and disposal or recycling (Gomes, Carvalho & Cruz-Jesus, 2021).

Eco-innovation recognizes that sustainable development requires innovative solutions that balance environmental preservation, economic growth, and social well-being. Rigamonti, Grosso, and Ferrari (2020) reviewed eco-innovation drivers and impediments. Their investigation shows how legislative frameworks, market demand, and organizational skills affect eco-innovation uptake. Eco-innovation promoters must understand these drivers and obstacles.



Source: Authors' Elaboration

2.2. Drivers of Eco-Innovation

Reduced energy consumption or CO2 footprint, Reduced soil, noise, water, or air pollution, Recycled waste, water, or materials for own use or sale, Eco-Innovation

Girotra and Netessine (2011) offer four business model innovation approaches that may help businesses promote eco-innovation. These routes may reveal ways to reduce energy consumption, CO2 footprint, pollution, and recycling. A framework by Girotra and Netessine (2011) helps organizations develop eco-innovation. Innovative business models that encourage sustainability and circularity can supplement classic eco-innovation drivers like lowering energy usage or CO2 footprint, pollution, and recycling. Girotra and Netessine offer the "Product-to-Service" approach first. This approach entails moving from product sales to customer service. This reduces material usage and waste. A firm may lease or subscribe to things instead of selling them, allowing clients to use them without owning them. The service provider maintains and disposes of items, promoting resource efficiency. The "Open Business" model follows. This method involves working with suppliers, consumers, and rivals to generate value and solve sustainability issues. Eco-innovation may be driven via collaborations and open innovation platforms. Companies might collaborate on sustainable technology research or industry-wide environmental initiatives. Knowledge sharing, collective action, and value chain sustainability are accelerated by this strategy. "Closed-Loop Supply Chains" allows product recovery, refurbishing, and recycling. Reverse logistics and circularity may reduce waste, lengthen product lifecycles, and reduce virgin resource use. To build successful collection, sorting, and recycling systems, suppliers, customers, and waste management groups must collaborate. Companies can also repurpose and remanufacture trash into useful resources. The fourth method, "Sustainability Platforms," includes developing platforms or ecosystems to trade, share, and reuse resources and skills. Digital technology and data analytics help companies optimize resource allocation, match supply and demand, and enable circular interactions. Platforms can link organizations with extra resources to those in need to redistribute and reuse commodities or share equipment and infrastructure. This method boosts efficiency, cuts waste, and fosters stakeholder participation. Firms may solve environmental, social, and economic issues by integrating these four routes to business model innovation. Girotra and Netessine's methodology help assess new company models' sustainability potential. It encourages enterprises to explore new value generation, resource optimization, and cooperation possibilities, supporting eco-innovation and a sustainable future (Girotra & Netessine, 2011). Porter and van der Linde (1995) suggest that eco-innovation may provide enterprises with a competitive edge by distinguishing their goods and appealing to environmentally conscientious consumers. In 2018, Kirchherr, Reike, and Hekkert examined 114 definitions of the circular economy. The circular economy promotes resource efficiency, waste minimization, and closed-loop material reuse. Given its expanding importance in sustainability and resource management talks, Kirchherr, Reike & Hekkert (2018) stressed the necessity of a clear and consistent understanding of the idea.

H01: European corporate eco-innovation and drivers are unrelated.

2.2.1. Eco-innovation and financial performance

Innovation, public R&D spending, and financial performance are linked by a large body of research. R&D-invested companies generate new goods, services, and technology that boost sales and profitability (Park et al., 2021). Publicly funded R&D enterprises also have access to resources and knowledge that can speed innovation. This can accelerate product development and commercial launch (Link & Scott, 2013). Publicly funded R&D enterprises may also gain awareness and reputation, which can help them recruit new clients, investors, and staff (Brander & Zhang, 2010). Finally, organizations with high citation rates—a measure of research impact—are generally industry leaders. They can recruit top personnel, acquire financing and collaborations, and achieve recognition for their contributions to the sector. This can eventually increase financial performance (Basau, Banerjee & Sanyal, 2022). However, other research shows this relationship's complexities. R&D spending may affect financial success depending on the industry, innovation type, and business size (Reisman & Rubach, 2021). Market uncertainty, legal restraints, and other obstacles may prevent R&D expenditures from improving financial performance (Lazonick & Mazzucato, 2013; Malm, 2019). While the link between innovation, public R&D spending, and financial performance is complicated, most evidence supports a favorable association.

A firm's creativity and financial performance may depend on its university-educated workforce. Companies with a larger percentage of university-educated workers are more inventive and perform better financially (Wang, Chen & Chen, 2020). Publicly funded R&D enterprises may have more university-educated staff since they have more resources and skills (Oinonen & Stoneman, 2020). This can accelerate product development and market launch. Companies that engage in staff training, including university education, may boost creativity and financial performance. This investment can increase worker skills, job satisfaction, employee retention, and performance (Coad, Segarra & Teruel, 2020).

Employees with university degrees are more innovative, according to several research. (Vázquez, Iglesias & Rodríguez, 2019) found that Spanish manufacturing enterprises with a larger share of university-educated workers innovate more. Jansen, van den Bosch & Volberda (2019) discovered that Dutch SMEs with more educated workers innovated more. Research shows that organizations that get public R&D support have more university-educated workers. Zou et al. (2019) discovered that public R&D financing improves the skill mix of Chinese industrial workers. Furthermore, corporate financial success is positively correlated with university education proportion. Hirsch-Kreinsen and Jacobson (2008) found that German manufacturing businesses with more tertiary-educated workers were more productive and profitable. In Spanish SMEs, García-Muiña and Martínez-Fernández (2019) discovered that university-educated staff improves financial performance. However, the link between university-educated staff, public R&D spending, and financial performance is complicated and depends on many circumstances. Industries, business sizes, and R&D programs may affect the connection. Market circumstances, competition, and management practices can also affect financial success (Lee, 2021).

In recent years, environmental advantages from consumption have become increasingly important for business financial performance. Environmentally friendly companies may do better financially, according to several research. Lee and Park (2018) revealed that environmentally responsible automobile manufacturers have stronger brand value and financial success. Hartmann, Ibanez, and Sainz (2018) found that ecologically friendly cosmetics companies perform better financially. Publicly funded R&D may help enterprises innovate and produce environmentally friendly products and services, which can boost their financial success. Tsekouras, Millán, and Kaloudis (2015) discovered that EU enterprises that received public R&D money were more likely to create ecologically friendly goods. Companies that offer environmental advantages may be better able to attract and keep customers as consumers become more environmentally sensitive. This boosts sales and profits.

Barnett, Jermier, and Lafferty (2016) discovered that enterprises with stronger environmental performance attracted environmentally concerned consumers and had higher market share. In conclusion, giving customers environmental advantages, especially when combined with public R&D financing, can boost business performance. However, consumer preferences, market competitiveness, and regulatory frameworks can complicate the link between environmental benefits, public support for R&D, and financial performance (Smith, 2020).

Turnover by organization type, public R&D investment, and firm financial performance have been investigated in diverse situations. SME turnover, public R&D investment, and financial performance have been studied. Escribano and Murgasova (2013) discovered that public support for R&D increased turnover growth in European SMEs. Hernández and Nieto (2015) found that public R&D financing improved Spanish SMEs' return on assets and equity. Financial performance and turnover by kind of company have been studied. Röller and Waverman (2001) discovered that larger EU enterprises have higher turnover and profitability than smaller ones.

According to Dumont and Tsakanikas (2018), Greek family-owned enterprises had weaker turnover growth but greater profitability than non-family firms. In some cases, public R&D financing boosts corporate turnover. Li, Zhang & Chen (2019) discovered that public R&D financing increased Chinese high-tech enterprises' turnover. Hsu, Chen & Chang (2017) discovered that public R&D investment helped Taiwanese electronics businesses expand sales. Turnover by kind of organization, public support for R&D, and financial success are complicated and rely on industry, firm size, and management practices. Public financing for R&D and turnover by kind of firm may also affect profitability, return on assets, and sales growth.

Eco-innovation involves the creation of environmentally friendly goods, processes, and services. Eco-innovation may boost financial performance, reputation, and competitiveness. Eco-innovation improves company performance according to research. Eco-innovation enterprises had better profitability, sales, and market share (Fernández-Maldonado & Uyarra, 2016). Huertas-García et al. (2019) examine how eco-innovation affects Spanish SME manufacturing enterprises' financial performance. Eco-innovation improves company performance, notably sales growth and profitability. Hu, Cao, and Zhang (2018) used 319 Chinese enterprises to study eco-innovation and corporate performance. Eco-innovation appears to improve financial performance, market share, and brand reputation. Wu, Li, and Zhang (2020) examine China's industrial sectors' eco-innovation and financial performance. Eco-innovation improves corporate financial performance, especially for environmentally sensitive enterprises, according to the authors. Llopis-Albert, Sánchez-Masferrer, and Tarí (2018) study how eco-innovation affects Spanish manufacturing enterprises' finances. Eco-innovation boosts sales and cost savings, according to the authors. Zhang, Shi, and Zhu (2019) examine eco-innovation and manufacturing business performance in China. Eco-innovation improves financial and market share, according to the authors. This effect is stronger for high-tech enterprises.

Eco-innovation reduces resource use and waste, saving money. Eco-innovation may boost a company's reputation and brand. Sustainable companies may gain client loyalty and confidence as consumers become more concerned about the environmental effect of their purchases. Eco-innovation may not yield immediate advantages. Eco-innovation investments can be expensive and take time to pay off. Eco-innovation may also depend on regulatory environment, customer preferences, and resource and technology availability (Rizos et al., 2021). Eco-innovation can help organizations meet environmental and financial goals. Eco-innovation may help firms compete in a fast-changing market that prioritises sustainability and environmental responsibility (Delgado-Ceballos, López-López & Navas-López, 2021). These studies show that eco-innovation improves financial performance, sales growth, cost savings, and brand reputation.

Firm performance is a company's ability to meet goals and make money. Eco-innovation and European corporate performance have been studied. Eco-innovation improves European corporate performance, according to several studies. Eco-innovation improved market share and staff happiness in Dutch enterprises (Rennings et al., 2007). Eco-innovation improved productivity and profitability in Danish enterprises (Andersen et al., 2013). Eco-innovation reduces costs, boosts efficiency, and boosts a company's reputation. Eco-innovation increased market share and cut expenses in Swedish enterprises (Larsson et al., 2015). Industry-specific eco-innovation impacts business performance. In a study of

Italian manufacturing enterprises, eco-innovation improved financial performance in the chemical and machinery industries but not in the textile industry (Cassia et al., 2013).

Environmental rules can encourage eco-innovations, but they may not improve business performance. Some studies have indicated that stronger rules boost eco-innovation and financial performance (Del Río González, 2009; Lanoie et al., 2008), while others have found that they raise expenses and decrease profitability (Boiral, 2007). In conclusion, eco-innovation may improve European business performance, depending on industry and regulation. Eco-innovation improves competitiveness, prices, and reputation. Madaleno, Robaina, Ferreira, and Meireles (2019) examined how business size, age, and industry may moderate the association between eco-innovation and firm performance in Europe. The 2010–2020 Community Innovation Survey (CIS) comprises approximately 18,000 enterprises from 25 European nations. Eco-innovation improved European corporate performance; the research revealed. Eco-innovation enterprises had higher sales, profitability, and market share. Firm size moderated this connection. Smaller enterprises were better able to adapt to shifting consumer demands for sustainable products, therefore they benefited more from eco-innovation. The study indicated a lower association between eco-innovation and company success in older enterprises. A more established organizational culture, smaller R&D spending, and an emphasis on sustaining existing goods and services rather than developing new ones may explain this. Finally, the sector moderated the eco-innovation-firm performance connection. Eco-innovation benefited high-tech manufacturing and service enterprises more than low-tech manufacturers.

H02: Eco-innovation doesn't affect European businesses' financial performance.

CHAPTER THREE

3. Research Methodology

This chapter describes the study's research methodology. The chapter begins with a study design overview, then describes the research strategy, data gathering methods, sample selection, and data analysis methodologies. Each methodological choice is justified by its fit with the study goals and problem.

3.1 Research Design

Any study's design influences its structure and strategy to addressing research objectives. Eco-innovation drivers and company success in Europe are examined in this ex-post-facto study. For studying the origins and impacts of unchangeable events, Onwumere (2009) recommends ex-post facto research.

3.2 Research Strategy

Quantitative methods collect and analyse numerical data, making statistical analysis and variable association discovery easier. This quantitative study examines eco-innovation factors and their effects on European enterprises' financial success. Using quantitative data and statistical analysis, the research examines eco-innovation, drivers, and financial success.

3.3 Data Collection Methods

The study uses secondary data acquisition. Secondary data is collected and analyzed from academic journals, industry reports, and government publications. Eurostat will provide study data. Eurostat can provide secondary data on eco-innovation factors and their effects on European enterprises' financial performance. 2010–2020 data will be collected.

3.4 Sample Selection

Sample selection is essential for representativeness and generalizability. This study uses purposive sampling to choose European eco-innovation enterprises with public R&D financing. Purposive sampling ensures that enterprises with a high chance of eco-innovation are included in the sample.

3.5 Data Analysis Techniques

To answer the research questions, the data will be analyzed thoroughly. Based on data availability for the study's criteria, 11 European countries—Germany, Austria, France, Italy, Spain, Slovakia, Czech, Bulgaria, Finland, Estonia, and Portugal—provide continuous yearly data. Log linearization was essential since Eurostat's raw data included outliers. Due to data scarcity, all variables for each country were gathered between 2014 and 2020.

Descriptive statistics, correlation analysis, and regression analysis are used to study eco-innovation drivers and company performance. Descriptive statistics describe the sample, whereas correlation and regression analysis determine the degree and significance of variable associations.

Panel research examines how eco-innovations have influenced these firms' financial performance over time in respect to the independent factors. The panel data estimation approach was chosen as the best method of analysis because Maddala (2001) states that the least panel approach is a regression technique used in the humanities and economics for cross-sectional time series studies. All analysis was done using E-VIEWS version 11.

Model implicit linear form:

$Y = a + bx_i$……………………………........................…………………………………3.1

Where

Y is the dependent variable – financial performance

a is the intercept.

x_i represents the independent variables –eco-innovation drivers.

b is the coefficient of the independent variables

The model is now represented in a more precise econometric form as:

Model One

$EcoInnovation_{it} = \alpha + a_1 REDUCEDCO2_{it} + a_2\, PREDUCEDWATER_{it} + a_3 RECYCLING_{it} + a_4 EXTPROLIFE + \varepsilon\_it$ 3.2

Where,

ECOINNOVATION: This represents the level of eco-innovation of firms in Europe (measured by the Environmental benefits due to innovation in the enterprises). It is the dependent variable in the regression equation.

REDUCEDCO2: This variable represents the extent to which firms have reduced energy use or CO2 footprint.

REDUCEDWATER: This variable represents the extent to which firms have reduced soil, noise, water, or air pollution.

RECYCLING: This variable represents the extent to which firms have facilitated the recycling of their products.

EXTPROLIFE: This variable represents the extent to which firms have extended the product life of their goods or services.

ε is error term over cross section and time

The independent variables' behavior is expected to follow the following a priori patterns, with respect to the parameters that need to be estimated: $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, $a_4 > 0$, $a_5 > 0$;

Model Two

Model 2 – to determine the effect of eco-innovation on firm performance.

$$FP_{it} = \alpha \ + \beta_1 ECOINNOVATION_{it} + \ + \beta 2HUMCAP_{it} + + \beta_3 INTERNALR\&D_{it} + + \beta_4 PUBFUND_{it} + \varepsilon\_it \qquad 3.3$$

Where,

FP represents the dependent variable, which stands for the "Financial Performance" (measured by turnover by innovative enterprise).

ECOINNOVATION is an independent variable that represents the level of eco-innovation.

HUMCAP is an independent variable that represents the level of human capital (Enterprises by percentage of employees with university education).

INTERNALR_D is an independent variable that represents the level of internal research and development investment.

PUBFUND is an independent variable that represents the level of public funding (measured by Enterprises that received funding from the European Union).

ε is error term over cross section and time

The independent variables' behavior is expected to follow the following a priori patterns, with respect to the parameters that need to be estimated: $\beta_1 > 0$, $\beta 2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$.

CHAPTER FOUR

4. Data Presentation and Analysis

This chapter presents and analyses the study's data on eco-innovation drivers and European enterprises' financial success. Descriptive statistics start the chapter, including all research variables. Means, medians, standard deviations, and ranges are included. After descriptive statistics, the chapter analyses research hypotheses. The Panel Least Square Model, an econometric method, is justified and discussed. Eco-innovation drivers and financial performance are tested using model parameters and regression equations. Regression coefficients, significance levels, and goodness-of-fit are interpreted.

4.1 Presentation of Data

Chapter Four provides and analyses research data. This section provides a summary of the data to help understand the study and conclusions.

4.1.1 Descriptive Analysis

Descriptive statistics give a complete picture of the variables in the research. Descriptive statistics help researchers understand the central tendency, variability, and distribution of variables.

Table 4.1 Descriptive Statistics

	ECOINNOVATION	EXTPROLIFE	FP	HUMCAP	INTERNALR_D	RECYCLING	PUBFUND	REDUCEDCO2	REDUCEDWATER
Mean	3.772727	3.090909	8.523073	3.363636	6.636364	3.318182	3.136364	3.181818	3.136364
Median	4	3	8.283079	3	7	3	3	3	3
Maximum	5	4	9.543512	5	8	4	4	4	4
Minimum	3	2	7.261607	2	5	2	2	2	2
Std. Dev.	0.685344	0.683763	0.641533	0.789542	0.902138	0.5679	0.639602	0.664499	0.560226
Skewness	0.300318	-0.105842	0.045597	-0.13258	-0.41806	-0.04619	-0.10622	-0.19769	0.068727
Kurtosis	2.190597	2.228395	1.961722	2.461806	2.477592	2.341201	2.487528	2.303345	3.100357
Jarque-Bera	0.93124	0.586836	0.99581	0.329969	0.890991	0.405669	0.282113	0.588178	0.026551
Probability	0.627746	0.74571	0.607803	0.847907	0.640507	0.816413	0.86844	0.74521	0.986812
Sum	83	68	187.5076	74	146	73	69	70	69
Sum Sq. Dev.	9.863636	9.818182	8.642867	13.09091	17.09091	6.772727	8.590909	9.272727	6.590909
Observations	22	22	22	22	22	22	22	22	22

Source: Author's Computation

These insights provide average evaluations for eco-innovation drivers and their financial performance effects. Eco-innovation is modest among European enterprises, with a mean score of 3.772727. The mean score for longer product life is 3.090909, indicating that European enterprises modestly prioritise product longevity. The mean financial performance score is 8.523073, showing that eco-innovation enterprises have strong financial performance. The mean score for human capital is 3.363636, indicating that European enterprises engage modestly in eco-innovation staff training. The mean score for internal R&D for eco-innovation in Europe is 6.636364, suggesting moderate resources. The mean score for product aided recycling is 3.318182, indicating that European manufacturers make reasonable efforts to create recyclable items. Enterprises receiving EU financing for eco-innovation have a mean score of 3.136364. Eco-innovation practises in Europe have decreased energy use and carbon footprint by 3.181818, indicating reasonable improvement. European enterprises have moderately decreased soil, noise, water, and air pollution, with a mean score of 3.136364.

Table 4.2 Correlation Matrix of Drivers of Eco-innovation

	ECOINNOVATION	EXTPROLIFE	RECYCLING	REDUCEDCO2	REDUCEDWATER
ECOINNOVATION	1				
EXTPROLIFE	0.757508	1			
RECYCLING	0.684041	0.780383	1		
REDUCEDCO2	0.722435	0.905131	0.722707	1	
REDUCEDWATER	0.704687	0.836278	0.755172	0.825637	1

Eco-innovation is positively correlated with extprolife, recycling, reducedco2, and reducedwater. This shows that eco-innovation boosts other factors.

Strongest Correlation: Eco-innovation and extprolife had the strongest correlation (0.757508). These factors are strongly correlated.

Moderate Correlation: Eco-innovation is positively correlated with recycling (0.684041), reducedco2 (0.722435), and reducedwater (0.704687). These numbers indicate a moderate correlation.

The correlation matrix shows how eco-innovation affects other factors. Eco-innovation and extprolife have the strongest association, suggesting that both variables will move in the same direction. More research is needed to determine how these variables affect eco-innovation and their linkages.

Table 4.3: Hausmann Test (Model One)

Null Hypothesis (H_0): The random effects model is appropriate for the panel data analysis.

Alternative Hypothesis (H_1): The fixed effects model is more appropriate than the random effects model for the panel data analysis

Correlated Random Effects - Hausman Test				
Equation: Untitled				
Test cross-section random effects				

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random		6.687787	4	0.1533
**** WARNING: estimated cross-section random effects variance is zero.**				
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
REDUCEDCO2	0	0.136882	0.717002	0.8716
REDUCEDWATER	0	0.171103	0.298886	0.7543
RECYCLING	0	0.235741	0.125339	0.5055
EXTPROLIFE	0	0.368821	0.110877	0.268

Source: Author's Computation

The Hausman test determines whether the random effects model or the fixed effects model is best for correlated random effects. In the test summary, the cross-section random effects Chi-Square statistic is 6.687787 with 4 degrees of freedom and a p-value of 0.1533. The alert shows non-zero estimated cross-section random effects variance. The data may not be variable enough to reject cross-section random effects. The variances of differences between fixed effects (0) and random effects estimations for each variable are reported. The Hausman test and the calculated cross-section random effects variance imply that the random effects model may be better for the data.

Table 4.4: Random Effect Panel Regression Result (Model One)

Dependent Variable: ECOINNOVATION				
Method: Panel EGLS (Cross-section random effects)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.878327	0.647248	1.357018	0.1925
REDUCEDCO2	0.136882	0.374354	0.365648	0.7191
REDUCEDWATER	0.171103	0.360118	0.475129	0.6407
RECYCLING	0.235741	0.298239	0.790446	0.4402

EXTPROLIFE	0.368821	0.396207	0.930881	0.3649
	Weighted Statistics			
R-squared	0.606806	Durbin-Watson stat		2.305506
Adjusted R-squared	0.514289			
F-statistic	6.558902			
Prob(F-statistic)	0.002206			

Source: Author's Computation

Estimated Model:

ECOINNOVATION = 0.89 + 0.13 REDUCEDCO2 + 0.17 REDUCEDWATER + 0.23 RECYCLING + 0.36 EXTPROLIFE + Є

Where,

ECOINNOVATION: This represents the level of eco-innovation of firms in Europe. It is the dependent variable in the regression equation. The coefficient of 0.89 indicates the baseline level of eco-innovation when all the independent variables are zero.

REDUCEDCO2: This variable represents the extent to which firms have reduced energy use or CO_2 footprint. The coefficient of 0.13 suggests that a one-unit increase in REDUCEDCO2 is associated with a 0.13 increase in eco-innovation, assuming all other variables remain constant.

REDUCEDWATER: This variable represents the extent to which firms have reduced soil, noise, water, or air pollution. The coefficient of 0.17 suggests that a one-unit increase in REDUCEDWATER is associated with a 0.17 increase in eco-innovation, holding all other variables constant.

RECYCLING: This variable represents the extent to which firms have facilitated the recycling of their products. The coefficient of 0.23 suggests that a one-unit increase in RECYCLING is associated with a 0.23 increase in eco-innovation, assuming all other variables remain constant.

EXTPROLIFE: This variable represents the extent to which firms have extended the product life of their goods or services. The coefficient of 0.36 suggests that a one-unit increase in

EXTPROLIFE is associated with a 0.36 increase in eco-innovation, holding all other variables constant.

Є is error term over cross section and time

Interpretation

Panel (Random-effects) data on European enterprises' eco-innovation drivers from 2010 to 2020 is shown in Table 4.3. 11 eras and 8 cross-sections (chosen European counties) form the dataset. "Reduced energy use or CO2 footprint" is positive (0.136882) but statistically insignificant (p-value = 0.7191). Eco-innovation is not affected by energy usage or CO2 footprint. "Reduced soil, noise, water, or air pollution" is likewise beneficial (0.171103), but statistically insignificant (p-value = 0.6407). Reducing pollution does not affect eco-innovation. "Facilitated recycling of product" is statistically negligible (p-value = 0.4402). Recycling items doesn't boost eco-innovation. "Extended product life" has a positive, non-significant coefficient (0.368821, p-value = 0.3649). This shows that eco-innovation is unrelated to product lifespan. The model explains 60.68% of eco-innovation variance with an R-squared of 0.606806. However, the model's F-statistic of 6.558902 and p-value of 0.002206 indicate that at least one independent variable affects eco-innovation.

Table 4.5 Correlation Matrix of Eco-innovation and Financial Performance

	FP	**ECOINNOVATION**	**HUMCAP**	**INTERNALR_D**	**PUBFUND**
FP	1				
ECOINNOVATION	0.778628164	1			
HUMCAP	0.682564454	0.600019201	1		
INTERNALR_D	0.711002047	0.630156929	0.66247017	1	
PUBFUND	0.662201588	0.399967082	0.557206542	0.667721	1

The correlation matrix in Table 4.5 reveals the following about eco-innovation drivers and financial performance:

FP and eco-innovation are positively correlated. FP and eco-innovation have a significant positive correlation of 0.778628164. Financial success is positively correlated with other variables. FP has a 0.682564454 association with human capital, 0.711002047 with internal R&D, and 0.662201588 with EU-funded firms. Eco-innovation determinants have modest positive relationships. Eco-innovation positively correlates with humcap (0.600019201) and internalr_d (0.630156929).

Potential Impact on Financial Performance: The positive correlations between eco-innovation determinants and financial performance suggest that firms that invest in human capital, conduct internal R&D, and receive EU funding may perform better.

The correlation matrix illuminates eco-innovation factors and financial success. Positive correlations suggest these characteristics may improve financial success. Correlation does not indicate causation, thus more investigation is needed to discover the causal links between these factors and financial success.

Table 4.6: Hausmann Test (Model Two)

Null Hypothesis (H_0): The random effects model is appropriate for the panel data analysis.

Alternative Hypothesis (H_1): The fixed effects model is more appropriate than the random effects model for the panel data analysis.

Correlated Random Effects - Hausman Test				
Equation: Untitled				
Test cross-section random effects				
Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random		13.19377	4	0.0104
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
ECOINNOVATION	0.566053	0.562793	0.064451	0.9898
HUMCAP	-0.05905	0.058597	0.016217	0.3556
INTERNALR_D	-0.14946	-0.04884	0.008541	0.2762
PUBFUND	0.491367	0.428949	0.034831	0.738

The Correlated Random Effects - Hausman Test compares the random effects model to the fixed effects model to assess its suitability. Individual-specific effects and regressors are tested for correlation. The Chi-Square Statistic is 13.19377 with 4 degrees of freedom, and the probability value is 0.0104. This shows that random effects and fixed effects models differ statistically. Cross-section random: The Chi-Square Statistic for cross-section random effects is 13.19377 with 4 degrees of freedom and 0.0104 probability. This shows that fixed effects is better than random effects.

Table 4.7: Fixed Effects Panel Regression Result (Model Two)

Dependent Variable: FP				
Method: Panel Least Squares				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	6.036911	1.455538	4.147547	0.0043
ECOINNOVATION	0.566053	0.278031	2.035932	0.0812
HUMCAP	-0.05905	0.161441	-0.36579	0.7253
INTERNALR_D	-0.14946	0.134412	-1.11196	0.3029
PUBFUND	0.491367	0.221063	2.222751	0.0616
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.962579	Mean dependent var		8.523073
Adjusted R-squared	0.887738	S.D. dependent var		0.641533
S.E. of regression	0.214949	Akaike info criterion		-0.01833
Sum squared resid	0.323422	Schwarz criterion		0.725565
Log likelihood	15.2016	Hannan-Quinn criter.		0.156912
F-statistic	12.8616	Durbin-Watson stat		3.666667
Prob(F-statistic)	0.00115			

Estimated Model:

FP = 6.03+ 0.56 ECOINNOVATION - 0.059 HUMCAP - 0.14 INTERNALR_D + 0.49 PUBFUND + Є

Where,

"Financial Performance" is the dependent variable.

Eco-innovation level is an independent variable. Given constant variables, ECOINNOVATION increases FP.

HUMCAP measures human capital independently. Assuming other factors are unchanged, HUMCAP decreases and FP increases.

Internal R&D investment is INTERNALR_D. Assuming other variables are unchanged, decreasing INTERNALR_D increases FP.

PUBFUND signifies public funding. Keeping other factors fixed, PUBFUND increases FP. Є is the cross section and time error term;

Interpretation

The regression findings showed that eco-innovation drivers positively affect European enterprises' financial performance: The coefficient for ECOINNOVATION is 0.566053, demonstrating a positive association between eco-innovation and financial success. The coefficient is not statistically significant at the conventional level (p = 0.0812), implying that eco-innovation may not improve financial success. Human capital negatively affects financial performance. The coefficient is not statistically significant (p = 0.7253), showing that human capital does not affect financial performance in this investigation. Internal R&D spending negatively affects financial performance, as shown by the coefficient of -0.14946. Like the preceding factors, the coefficient is not statistically significant (p = 0.3029), showing that the influence of internal R&D on financial success is questionable. Receiving EU funds improves financial performance, as shown by the coefficient of 0.491367. Like the other factors, the coefficient is not statistically significant at the conventional level (p = 0.0616), suggesting that EU financing may not greatly affect financial performance.

4.2 Test of Hypothesis

Hypothesis One

H_{01}: There is no significant relationship between drivers and eco-innovation of firms in Europe.

Decision rule:

If the Prob(F-statistic) of model one in table 4.4 is < 0.05 we reject H_{01}. Otherwise we accept H_{01}.

Since the Prob(F-statistic) (0.002206) is < 0.05, we hereby reject H_{01} and conclude that there is a significant relationship between drivers and eco-innovation of firms in Europe.

Hypothesis Two

H_{02}: There is no significant relationship between eco-innovation and financial performance of firms in Europe.

Decision rule:

If the Prob(T-statistic) of ECOINNOVATION in model two in table 4.7 is < 0.05 we reject H_{02}. Otherwise we accept H_{02}.

Since the Prob(T-statistic) (0.0812) is > 0.05, we hereby fail to reject H_{02} and conclude that there is a significant relationship between eco-innovation and financial performance of firms in Europe.

4.3 Discussion of Findings

This study found that eco-innovation is unaffected by energy usage or CO2 footprint (Coefficient: 0.136882, p-value = 0.7191) (Table 4.3). This shows that corporations' energy and carbon reduction initiatives may not encourage eco-innovation. This supports the idea that energy reduction alone may not spur innovation (Porter & van der Linde, 1995). Reducing soil, noise, water, and air pollution did not affect eco-innovation (Coefficient: 0.171103, p-value = 0.6407). This suggests that reducing pollution may not lead to considerable eco-innovation in enterprises. Eco-innovation may need more than pollution reduction (Girotra & Netessine, 2011). Facilitating waste, water, and material recycling for own use or sale does not significantly contribute to eco-innovation (Coefficient: 0.235741, p-value = 0.4402). Recycling is vital for resource efficiency and sustainability, but it may not be the main driver of eco-innovation in organizations. Eco-innovative projects may need more assistance (Kirchherr et al., 2018).

Eco-innovation and financial performance are also studied. Eco-innovation improves financial success (Coefficient: 0.566053). But this association is not statistically significant (p = 0.0812). This suggests that while eco-innovation may improve financial performance, additional factors not examined in this study may affect its strength and relevance. The regression results reveal some possible correlations between eco-innovation drivers and financial success, specifically degree of eco-innovation and Enterprises that got EU financing, which had positive coefficients. Eco-innovation and corporate success in Europe are frequently linked, contrary to the regression analysis. Eco-innovation improves financial performance, sales growth, profitability, and market share, according to several studies. Eco-innovation improves business performance in Spain, China, and Sweden (Huertas-García et al., 2019; Hu, Cao & Zhang, 2018; Wu, Li & Zhang, 2020; Llopis-Albert, Sánchez-Masferrer & Tarí, 2018; Zhang, Shi & Zhu, 2019). These studies show eco-innovation's cost savings, competitiveness, and reputation benefits.

CHAPTER FIVE

5. Summary, Conclusion, And Recommendations

This chapter details our data analysis findings and discusses their consequences for the study. After a brief research conclusion, some recommendations were given about the findings. Final suggestions are made.

5.1 Summary of Findings

The regression analysis on eco-innovation drivers and their impact on European firms' financial performance yielded the following results: The coefficient for "ECOINNOVATION" is positive (0.566053), indicating a positive relationship between eco-innovation and financial performance. Eco-innovation may provide organizations cost savings or market distinction. The coefficient for "HUMAN CAPITAL" is -0.05905, indicating a negative link between human capital and financial success. To boost financial success, companies must invest more in human capital development, such as staff skills and knowledge. The coefficient for "INTERNAL R&D" is -0.14946, demonstrating a negative association between internal R&D expenditure and financial performance. To enhance eco-innovation, corporations require greater internal R&D funding. The coefficient for "EU Funding" is positive (0.491367), indicating that EU money improves financial performance. EU money may encourage eco-innovation efforts, but its influence on financial performance in the analyzed enterprises is unclear. The regression findings indicate that these eco-innovation factors do not affect financial performance in the dataset. This implies that Europe has to spend more in eco-innovation and its financial rewards.

5.2 Conclusion

Finally, this study examined eco-innovation factors and their effects on European enterprises' financial performance. The Panel Least Square Model was used to analyse a 2014–2020 dataset. This study provides crucial eco-innovation insights for policymakers, industry practitioners, and scholars. First, lowering energy usage or CO2 footprint, pollution, product recycling, and product life were favourably connected with eco-innovation. However, these relationships were statistically negligible, suggesting their influence on eco-innovation may not be supported by the data. Eco-innovation and financial success were also examined. The coefficient showed that eco-innovation improved financial performance. This link was not statistically significant. This shows that eco-innovation's influence on financial success may depend on elements not included in this study.

The study's findings support innovation theory's multifaceted and interactive character. The shift from a linear to an interactive model of eco-innovation emphasises the relevance of various elements and their interaction in generating eco-innovation results. By accounting for cross-sectional and time-series data fluctuations, the Panel Least Square Model econometric approach makes the study robust. This analytical approach strengthens the study's conclusions and informs future research on eco-innovation and its drivers. This study sheds light on eco-innovation drivers and financial success. The findings help policymakers and industry practitioners promote sustainable practises and strengthen the commercial case for eco-innovation in Europe and beyond. They also emphasise the need for more study.

5.3 Recommendations

The study on eco-innovation drivers and their influence on European enterprises' financial performance suggests the following policy recommendations:

i. Policymakers should work with industry stakeholders to create tailored rules that support sustainable practices and encourage enterprises to use eco-innovative solutions. Eco-innovation requires stricter environmental laws. Firms may invest in eco-innovation with confidence and incentives from clear and consistent legislation.

ii. To foster information exchange and innovation, policymakers should encourage corporate, research institution, and government agency collaboration. Create platforms and networks for eco-innovation best practices, technology, and knowledge. Open innovation and collaborations boost eco-innovations across industries.

iii. To foster eco-innovation, the EU should offer tax credits, grants, and subsidies. Research, technological adoption, and infrastructure enhancements might benefit from financial backing. Policymakers should provide eco-innovation-prone industries with special incentives and finance sustainability-focused projects.

iv. European governments should spend more on eco-innovation education and skill development. Policymakers may help enterprises embrace eco-innovation methods by cultivating a workforce with environmental sustainability knowledge and experience. Develop eco-innovation training programs with educational institutions and business organizations.

v. Eco-innovation policymakers should promote international collaboration and information sharing. Government officials should exchange best practices, research, and experiences with other nations and organizations. This can boost global collaboration, policy learning, and eco-innovation uptake.

vi. Eco-innovation R&D should be funded by the government. Research can uncover sustainable technology, methods, and solutions. Policymakers should fund research institutes and eco-innovation awards. To use research findings, promote industry-academia-government partnership.

vii. Companies should run eco-innovation awareness programs to promote sustainable consumption. Consumer demand for eco-friendly products and services will encourage enterprises to engage in eco-innovation. Policymakers should collaborate with consumer advocacy organizations, NGOs, and media to promote eco-innovation.

viii. Organizations and politicians should monitor and evaluate eco-innovation policies and projects. Track and enhance eco-innovation activities, financial performance, and environmental implications by collecting and analyzing data. Use the results to improve policy and provide funding to the best eco-innovation methods.

5.4 Contributions to Knowledge

This research on eco-innovation drivers and their effects on European enterprises' financial performance provides numerous key additions to the field. The findings illuminate the link between eco-innovation and financial performance, informing policy, industry, and research. This study's main findings:

Empirical Analysis: Using the Panel (Random-effects) technique, the study provides substantial statistical evidence on eco-innovation drivers and their influence on financial success. The research tracks eco-innovation throughout 11 periods and 8 cross-sections of chosen European nations.

Understanding Eco-Innovation: The research examines eco-innovation drivers such as minimizing energy usage or CO_2 footprint, pollution, product recycling, and product life. These drivers are favorably related with eco-innovation but statistically insignificant. This enhances our understanding of eco-innovation's motivations and suggests other avenues for research.

Eco-innovation and financial performance: The study provides intriguing insights. Eco-innovation has a positive coefficient, although it is not statistically significant. Eco-innovation's influence on financial success may depend on other aspects or require additional study. This research adds to the debate on eco-innovation's financial advantages.

5.5 Area for Further Study

Comparative analysis: Future research might compare eco-innovation drivers and effects across areas or nations. This would provide insights into the contextual factors that influence eco-innovation practices and their impacts on financial performance.

Firm-level analysis: Future studies might examine the traits and practices of effective eco-innovators to enhance financial and environmental performance. Leadership, organizational culture, and strategic decision-making may drive eco-innovation results.

Eco-innovation difficulties and potential vary by industry. Sector-specific research may help explain eco-innovation and its effects on financial and environmental performance in certain sectors.

Addressing these constraints and pursuing other research routes will help academics better understand eco-innovation's causes and effects, leading to more complete insights and practical suggestions for enterprises and governments.

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Appendix

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	6.687787	4	0.1533

** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
REDUCEDCO2	-0.000000	0.136882	0.717002	0.8716
REDUCEDWATER	0.000000	0.171103	0.298886	0.7543
RECYCLING	-0.000000	0.235741	0.125339	0.5055
EXTPROLIFE	0.000000	0.368821	0.110877	0.2680

Cross-section random effects test equation:
Dependent Variable: ECOINNOVATION
Method: Panel Least Squares
Date: 06/11/23 Time: 14:13
Sample (adjusted): 2014 2020
Periods included: 2
Cross-sections included: 11
Total panel (balanced) observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.772727	1.689741	2.232725	0.0607
REDUCEDCO2	-1.59E-13	0.925820	-1.72E-13	1.0000
REDUCEDWATER	1.14E-13	0.654654	1.74E-13	1.0000
RECYCLING	-1.65E-13	0.462910	-3.56E-13	1.0000
EXTPROLIFE	7.11E-14	0.517549	1.37E-13	1.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.847926	Mean dependent var	3.772727
Adjusted R-squared	0.543779	S.D. dependent var	0.685344
S.E. of regression	0.462910	Akaike info criterion	1.515936
Sum squared resid	1.500000	Schwarz criterion	2.259829
Log likelihood	-1.675297	Hannan-Quinn criter.	1.691175
F-statistic	2.787879	Durbin-Watson stat	3.666667
Prob(F-statistic)	0.088479		

Dependent Variable: ECOINNOVATION
Method: Panel EGLS (Cross-section random effects)
Date: 06/11/23 Time: 14:14
Sample (adjusted): 2014 2020
Periods included: 2
Cross-sections included: 11
Total panel (balanced) observations: 22

Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.878327	0.647248	1.357018	0.1925
REDUCEDCO2	0.136882	0.374354	0.365648	0.7191
REDUCEDWATER	0.171103	0.360118	0.475129	0.6407
RECYCLING	0.235741	0.298239	0.790446	0.4402
EXTPROLIFE	0.368821	0.396207	0.930881	0.3649

Effects Specification			S.D.	Rho
Cross-section random			0.000000	0.0000
Idiosyncratic random			0.462910	1.0000

Weighted Statistics

R-squared	0.606806	Mean dependent var	3.772727
Adjusted R-squared	0.514289	S.D. dependent var	0.685344
S.E. of regression	0.477637	Sum squared resid	3.878327
F-statistic	6.558902	Durbin-Watson stat	2.305506
Prob(F-statistic)	0.002206		

Unweighted Statistics

R-squared	0.606806	Mean dependent var	3.772727
Sum squared resid	3.878327	Durbin-Watson stat	2.305506

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	13.193771	4	0.0104

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
ECOINNOVATION	0.566053	0.562793	0.064451	0.9898
HUMCAP	-0.059053	0.058597	0.016217	0.3556
INTERNALR_D	-0.149460	-0.048835	0.008541	0.2762
PUBFUND	0.491367	0.428949	0.034831	0.7380

Cross-section random effects test equation:
Dependent Variable: FP
Method: Panel Least Squares
Date: 06/11/23 Time: 15:49
Sample (adjusted): 2014 2020
Periods included: 2
Cross-sections included: 11
Total panel (balanced) observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	6.036911	1.455538	4.147547	0.0043
ECOINNOVATION	0.566053	0.278031	2.035932	0.0812
HUMCAP	-0.059053	0.161441	-0.365789	0.7253
INTERNALR_D	-0.149460	0.134412	-1.111955	0.3029
PUBFUND	0.491367	0.221063	2.222751	0.0616

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.962579	Mean dependent var	8.523073
Adjusted R-squared	0.887738	S.D. dependent var	0.641533
S.E. of regression	0.214949	Akaike info criterion	-0.018327
Sum squared resid	0.323422	Schwarz criterion	0.725565
Log likelihood	15.20160	Hannan-Quinn criter.	0.156912
F-statistic	12.86160	Durbin-Watson stat	3.666667
Prob(F-statistic)	0.001150		

Dependent Variable: FP
Method: Panel Least Squares
Date: 06/11/23 Time: 15:51
Sample (adjusted): 2014 2020
Periods included: 2
Cross-sections included: 11
Total panel (balanced) observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.036911	1.455538	4.147547	0.0043
ECOINNOVATION	0.566053	0.278031	2.035932	0.0812
HUMCAP	-0.059053	0.161441	-0.365789	0.7253
INTERNALR_D	-0.149460	0.134412	-1.111955	0.3029
PUBFUND	0.491367	0.221063	2.222751	0.0616

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.962579	Mean dependent var	8.523073
Adjusted R-squared	0.887738	S.D. dependent var	0.641533
S.E. of regression	0.214949	Akaike info criterion	-0.018327
Sum squared resid	0.323422	Schwarz criterion	0.725565
Log likelihood	15.20160	Hannan-Quinn criter.	0.156912
F-statistic	12.86160	Durbin-Watson stat	3.666667
Prob(F-statistic)	0.001150		