

DRIVERS OF GREEN TECHNOLOGY ADOPTION IN SMES: EMPIRICAL EVIDENCE FROM BOSNIA AND HERZEGOVINA

Kenan BEŠIREVIĆ

International Burch University, Bosnia and Herzegovina

kenan.besirevic@stu.ibu.edu.ba

Ermin CERO

International Burch University, Bosnia and Herzegovina

ermin.cero@ibu.edu.ba

Abstract

The transition towards environmentally sustainable business practices has become a growingly important strategic priority for small and medium-sized enterprises (SMEs), especially in those countries which aspire for the closer integration with the European Union. This analysis examines the determinants of green technology adoption and their impact on the growth of sustainable investment in SMEs in Bosnia and Herzegovina. The research is based on the Resource-Based View and Institutional Theory to explore the impact of financial capacity, institutional support, managerial awareness and perceived benefits of green investments comparing the enterprises operating in the Federation of Bosnia and Herzegovina and Republika Srpska. The empirical analysis is based on data collected from 150 SMEs through a structured questionnaire. Descriptive statistics, reliability analysis, independent-samples t-test, Pearson correlation and multiple linear regression analyses were performed with IBM SPSS Statistics. The results show significant differences in the adoption of green technologies between the two entities, confirming the relevance of the institutional environment. The regression analysis further shows that managerial awareness and perceived benefits of green investments are the strongest predictors of sustainable investment growth, while financial capacity and institutional support do not exert significant independent effects after controlling for other variables. The findings emphasize the relevance of managerial capabilities and strategic orientation in accelerating the green transition of SMEs. The study contributes to the scarce empirical evidence on green technology adoption in Bosnia and Herzegovina and offers practical recommendations for business managers and policymakers who want to strengthen sustainable business development and environmental competitiveness.

Key words: Green technology adoption; SMEs; Sustainable investment growth; Green transition; Managerial awareness; Bosnia and Herzegovina; CBAM

JEL Classification: Q56; O32; M21; L26

1. INTRODUCTION

The world's move towards sustainable economic development has dramatically altered the competitive landscape for businesses. Due to growing environmental concerns, increasing regulatory requirements, technological innovation and stakeholder expectations, firms are integrating sustainability into their long-term business strategies. Green technologies, renewable energy solutions and environmentally responsible production processes are increasingly perceived not only as tools for reducing environmental impacts but also as important drivers of competitiveness, innovation and economic growth. These developments have acquired particular significance for small and medium-sized enterprises (SMEs), the backbone of most national economies and a key element in employment creation, value creation and regional development. The European Green Deal and the Carbon Border Adjustment Mechanism (CBAM) have sped up the European agenda for businesses needing to adopt environmentally sustainable technologies. Export-oriented SMEs in Bosnia and Herzegovina are increasingly exposed to European environmental standards through international supply chains and market integration, not yet as a member of the European Union. Therefore, there is increasing pressure on enterprises to enhance energy efficiency, reduce carbon emissions and modernize production processes so that they can remain competitive in the European markets.

Increasing importance of green transition but uneven adoption of green technologies among SMEs especially in developing and transition economies. Key determinants of sustainable business transformation have been identified in previous studies as financial constraints, limited institutional support, technological uncertainty and managerial capabilities. However, empirical evidence on these determinants in the setting of Bosnia and Herzegovina is still scarce. Furthermore, little attention has been paid to understanding how recent European environmental policies influence the investment decisions of domestic SMEs. This study fills this research gap by examining the determinants of green technology adoption in SMEs in Bosnia and Herzegovina and its effect on sustainable investment growth. More specifically, the study evaluates the role of financial capacity, institutional support, managerial awareness and perceived benefits of green investments comparing the enterprises operating

within the Federation of Bosnia and Herzegovina and Republika Srpska. The study also investigates whether institutional differences result in different rates of green technology adoption in the two entities.

This research contributes to the literature in several ways. First, it adds to the empirical knowledge on the determinants of green technology adoption in a transition economy, where evidence is still relatively scarce. Second, it combines organizational and institutional perspectives using the Resource-Based View and Institutional Theory. Finally, the study offers practical recommendations for managers, policymakers and business support institutions aiming to speed up the green transition and improve the long-term competitiveness of SMEs in Bosnia and Herzegovina.

2. LITERATURE REVIEW

2.1. TRANSITIONING SMES TO GREEN

The drive towards environmentally sustainable business practices is a major challenge for small and medium size enterprises (SMEs) globally. Rising environmental awareness, tougher regulations, higher energy prices and changing consumer tastes are driving a range of sectors to adopt green technologies. In Europe sustainability is no longer a CSR action but a strategic factor for long term competitiveness, innovation and resilience. SMEs represent more than 99% of all European companies and make a major contribution to jobs and economic value. Thus, their effective inclusion is vital to wider climate and sustainable development goals in the green transition. Green transition is the process of switching to environmentally friendly production and business processes in the sphere of renewable energy sources, energy efficient technologies, sustainable resource management, waste reduction and low-carbon production processes. It's not a tech bet on the green shift. This is a set of management changes to embed environmental issues in strategic planning, operations and long-term business development.

For SMEs this transition is often characterized by a search for a balance between environmental goals and the constraints of financial resources, technological capabilities and dynamics of the market. Sustainability is becoming increasingly important and is changing the competitive environment for SMEs. Customers, investors, financial institutions and supply chain partners are demanding that companies prove their standards of environmental responsibility and sustainability. Companies that adopt green technologies can increase their operating efficiency and reduce their energy use, while also improving their corporate image and enhancing their market position. Research has found that green technology investments can produce long-term economic benefits such as lower costs, improved innovation and greater resilience to market and regulatory uncertainty. The European Green Deal sets out an ambitious roadmap for the European Union to achieve climate neutrality and deliver sustainable economic growth. There is a suite of policy instruments to encourage firms to improve energy efficiency and reduce greenhouse gas emissions and increase the use of renewable energy. Bosnia and Herzegovina is not yet an EU member state, but European environmental policies are increasingly affecting the country's companies, in particular SME-exporters, as they are becoming part of international supply chains and are dependent on the markets of the EU. This provides a motivation for companies to improve their production process and to use environmentally sustainable technologies.

One of the latest developments for SMEs has been the introduction of the Carbon Border Adjustment Mechanism (CBAM). This is to avoid carbon leakage by applying carbon-related costs on goods entering the EU. The CBAM is a regulatory challenge, but also an opportunity for SMEs exporting to EU markets to upgrade their technology. Investment in cleaner production technologies, energy-efficient equipment and renewable energy systems can enhance long-term competitiveness and reduce potential compliance costs associated with future environmental regulations. Thus, external pressure of regulation has become an important factor to influence the strategic investment decisions of SME. The advantages of green technologies are well recognized. However, the adoption of green technologies is not uniform among developing and transition economies. Small and medium-sized enterprises often lack the financial resources, access to external financing, institutional support, technological uncertainty and managerial expertise necessary for the successful implementation of sustainable innovations. Big companies have more resources than small companies to go green. They have the investment capacity; they have the organizational resources. Hence, a supportive institutional environment and organizational readiness are the key determinants of the speed of green technology adoption.

The literature identifies some internal and external factors influencing SMEs' environmental change. Some of the internal factors are financial strength, managerial awareness, strategic commitment, organization capabilities

and orientation towards innovation. External factors include government incentives, institutional support, regulatory requirements, customer expectations, competitive pressure, and availability of technological knowledge. Financial resources are, among other things, still among the most powerful predictors of successful green investment. Still, management's main commitment driver is organizational change. Furthermore, the latest studies provide growing evidence on the role of regulatory mechanisms such as CBAM in shaping the sustainability-oriented investment decisions of export-oriented firms. There is a lot of international research on the adoption of green technology in developed economies, but the empirical evidence in the case of BiH is still very scarce. Much of the work to date has been on environmental policy or the feasibility of renewable energy. Organizational and institutional factors influencing the adoption of green technologies by SMEs have received little attention.

Furthermore, the impact of the latest European sustainability policies, especially CBAM on Bosnian SMEs, has not been widely researched. Filling this gap in research provides important lessons about the drivers of the green transition in emerging economies, and deeper insights into the ways SMEs respond to changing environmental and market demands.

2.2. DRIVERS OF GREEN TECHNOLOGY ADOPTION

The adoption of green technologies by small and medium-sized enterprises is determined by internal organizational resources and external institutional and market dynamics. The Resource-Based View theory (RBV) argues that the adoption of green technology is influenced by the availability and use of firm-specific resources such as financial capital, managerial knowledge, technological capabilities and strategic commitment (Barney, 1991). This view is supported by the Institutional Theory, which states that regulation, public policy, stakeholder expectation and market pressure influence organizations behavior (DiMaggio & Powell, 1983). Therefore, the greening of SMEs cannot be attributed to one single factor, but rather has to be seen as a multi-dimensional process. This is a result of the interaction between the organizational capabilities and the wider business environment.

2.2.1. ABILITY TO PAY STANDARD

A leading factor that is often cited affecting SMEs' adoption of green technology is financial capacity. Renewable energy systems, energy efficient equipment, cleaner production technologies, digital monitoring solutions and environmental management systems often have a high entry cost. Such investments can generate long-term savings, productivity and environmental benefits, but the initial costs can be a major barrier for SMEs with limited internal resources. Generally, small and medium-sized firms have fewer assets, less collateral, shorter credit histories and less bargaining power in financial markets and are therefore generally less able than large firms to obtain long-term financing. Therefore, investment decisions are often confined to internally generated funds, loans from commercial banks and grants or public co-financing schemes. Constraints may push firms to postpone green investment, while managers view it as long-term value (European Investment Bank, 2023).

The Resource-Based View says that financial capital is an enabling resource in the organization. It enables firms to obtain new technologies, upgrade production processes, improve energy efficiency and develop capabilities in respect of sustainability (Barney, 1991). But financial resources do not necessarily lead to the adoption of green technologies. Nevertheless, firms with the same financial capabilities can present different investments in environmental matters because of different strategic priorities, managerial commitment and perception of expected benefits (Del Río, Peñasco, & Romero, 2016). Thus financial capacity should be understood as a necessary enabling condition, not a sufficient explanation of sustainable transformation. Public grants, subsidized loans, guarantees, tax incentives and co-financing can help to reduce the financial risks of green investment. The instruments are of particular importance in transition economies where green finance markets are still nascent and SMEs rely on their own resources. Access to affordable long-term capital is limited in Bosnia and Herzegovina, which can limit investment in renewable energy, efficient production equipment, and technological modernization. But the effect of financial capability may depend on managerial knowledge and strategic orientation of the firms to optimally use these available resources.

2.2.2. SUPPORT FROM INSTITUTIONS

Institutional support refers to support provided by governments, public institutions, development agencies, financial organizations, chambers of commerce, research institutions and other business support organizations in the form of financial, regulatory, technical and advisory support. Such support could include subsidies, grants, concessional credit terms, tax incentives, technical assistance, information services, training programmers and regulatory guidelines. Institutional Theory argues that organizations are subject to formal rules, government policies, industry norms, and expectations of important stakeholders (DiMaggio & Powell, 1983). Institutions supporting the green transition could contribute to reducing uncertainty; improving access to information; lowering the cost of investment and increasing the capacity of SMEs to adopt environmentally sustainable technologies. Public intervention is particularly relevant, since many SMEs lack the specialized staff to assess the technical, financial and regulatory implications of green investments. Previous studies have revealed that government incentives and public support programs could enhance the chances of SMEs' adoption of eco-innovations, renewable energy solutions and cleaner production technologies (Horbach, Rammer, & Rennings, 2012). But the success of institutional support depends not only on the amount of money available but also on the accessibility of the program, the efficiency of administration, the consistency of policies and the transparency of application procedures. The fragmented responsibilities, complex requirements, low information dissemination and long approval processes may limit the effective use of existing support mechanisms by the SMEs. This is particularly the case in Bosnia and Herzegovina, where the implementation of environmental protection, energy policy and SME development is carried out within a fragmented institutional framework. Different procedures of regulation, incentive system and institutional access might face small and medium size enterprises working in Federation of Bosnia and Herzegovina and RS. These differences can affect their investment decisions and the ability to adopt green technologies. Thus, in the master study, the institutional support is treated as an external determinant, whose effect may depend on the institutional context of the location of the enterprise.

2.2.3. THE MANAGEMENT'S CONSCIENCE

Managerial awareness is the extent to which owners and managers are aware of environmental issues, sustainability regulations, technological opportunities, and strategic business benefits of green investment. It refers to environmental consciousness, foresight of future regulatory risks, sustainability orientation and capacity to incorporate environmental issues in strategic business planning. This is especially true for SMEs where strategic and investment decisions are often made by a small group of owners/senior managers. SMEs are often more directly dependent upon the views, knowledge and priorities of individual decision-makers than large firms that can benefit from dedicated environmental or sustainability divisions. The extent of managers' engagement may therefore have a big influence on whether sustainability is perceived as an additional cost, a compliance requirement or a strategic opportunity.

According to (Barney, 1991), the RBV focuses on the significance of intangible resources like management knowledge and decision-making capabilities that can result in innovation and sustained competitive advantage. Managers who recognize the economic and strategic advantages of green technologies are more likely to invest in renewable energy, energy efficiency, cleaner production, employee training and environmental monitoring. They are also more likely to see regulatory changes coming, find sources of financing and embed sustainability in their business models. (Bansal, 2003) has highlighted the significance of managerial values, leadership commitment and strategic vision in determining the organizational response to environmental issues. Managers who see sustainability as an opportunity for innovation, cost reduction, reputation and market competitiveness instead of a burden of compliance are more likely to develop proactive environmental strategies (Aragón-Correa, Hurtado-Torres, Sharma, & García-Morales, 2008). Managers' awareness allows the organization to learn. Green technologies usually include new technical know-how, training of personnel, redesign of processes and continuous adjustment. To summarize, managers that foster learning and progress are better placed to utilize the financial and institutional resources at their disposal to make concrete investments in sustainability. However, awareness alone may not suffice if firms lack adequate funding, technical know-how or institutional support. Thus, its effects should be considered along with other factors that influence the adoption of green technology.

2.2.4. CBAM FOCUS

Another external regulatory and market pressure from the EU is the emerging Carbon Border Adjustment Mechanism. The European Green Deal proposed the introduction of the CBAM as a means to prevent carbon leakage and to impose a carbon price on selected imports equivalent to the price paid by producers under the EU Emissions Trading System. This mechanism will initially cover high carbon emitting sectors including iron and steel, aluminum, cement, fertilizers, electricity and hydrogen. The CBAM provides immediate and longer-term incentives for non-EU SMEs to monitor emissions, increase energy efficiency, move to renewable energy and upgrade their production processes. SMEs that export covered goods directly could have reporting and carbon related compliance obligations, while other SMEs could be indirectly pressured by European buyers to provide information on emissions, energy sources and environmental performance across their supply chains.

Institutional actors describe CBAM as a form of coercion, linking access to EU markets with compliance with environmental and carbon reporting requirements. It also changes the customer expectations and the competitive environment in which exporters compete thus putting pressure on the market. Producers using more carbon intensive production methods will probably have higher compliance costs and a weaker market position. Companies that invest in cleaner technologies will be more competitive and less vulnerable to future regulatory changes. The CBAM can therefore be a regulatory burden, but also a driver of technological modernization. Investing in renewable energy, energy-efficient equipment, carbon monitoring systems and cleaner production can help companies remain in European supply chains, reduce emissions and improve operational efficiency. Export-oriented SMEs in Bosnia and Herzegovina are particularly sensitive to the pressure because the EU is the most important market for the country's trade.

However, the impact of CBAM can be sector specific depending on export intensity, technological preparedness, financial resources and the awareness of regulatory changes of the enterprise. SMEs with more organizational resources may be more proactive in increasing green investment. In contrast, the mechanism might be seen as an additional administrative and financial burden for the financially strained companies. In addition, the study on the role of CBAM in Bosnia and Herzegovina is relevant since there is a lack of empirical evidence on the impact of CBAM on the investment behavior of SMEs in non-EU transition economies.

2.3. FORMULATION OF HYPOTHESES

The literature reviewed in the previous sections indicates that the adoption of green technologies by SMEs is influenced by both internal organizational capabilities and external institutional conditions. Based on the Resource-Based View and Institutional Theory, the study proposes three research hypotheses for the investigation of the differences in the adoption of green technology and the connection between green investment and sustainable investment growth in SMEs in Bosnia and Herzegovina. The hypotheses are directly related to the conceptual framework and the variables measured in the survey instrument developed for this study.

H1: Institutional Differences and Green Technology Adoption

Institutional Theory argues that variations in institutional quality, administrative procedures, public policies and regulatory systems affect organizational behavior. The Federation of Bosnia and Herzegovina FBiH and RS have different institutional and administrative structures. Thus, micro, small and medium enterprises shall be impacted differently in respect of financial support, environmental incentives and policy implementation for sustainable development. We hypothesize that these institutional differences will impact the degree to which firms adopt green energy and environmentally friendly technologies.

Hence, the first hypothesis is written as:

H1: The level of green technology adoption between SMEs operating in Federation of Bosnia and Herzegovina and SMEs operating in RS is statistically significantly different.

H2 Drivers of the Green Transition and Institutional Settings

The green transition is driven not only by the available resources but also by managers' perception of the factors that facilitate or hinder the green transition. Institutional Theory implies that the emphasis given to financial capacity, institutional support, managerial awareness and regulatory pressures may vary across organizations operating in different regulatory and policy environments. Thus, the perception of SMEs on determinants influencing the adoption of green technology might be affected by the differences in public support mechanisms and administrative systems between the two entities.

From these arguments we are led to the following second hypothesis:

H2: There are significant differences in the perception of determinants of adoption of green technology in SMEs in Federation of Bosnia and Herzegovina and RS.

H3: Adoption of Green Technology and Sustainable Investment

The Resource-Based View views investment in valuable organizational resources and innovative technologies as strategic assets that can offer a long-term competitive advantage. Green technologies can improve the efficiency of operations, reduce production costs, access international markets and enhance the competitiveness of firms. So, the more businesses deploy sustainable technologies and green energy, the more they will see growth in sustainable investment. The strength of this relationship may differ between the two entities due to different institutional environments in which SMEs operate in Bosnia and Herzegovina. Then the third hypothesis is formulated as follows:

H3: The adoption of green technology has a positive influence on the growth of sustainable investment in SMEs, and the intensity of the relationship is different in the FBiH and RS.

3. RESEARCH METHODOLOGY AND RESULTS

3.1. RESEARCH DESIGN

The present research used a quantitative cross-sectional comparative research design to explore the determinants of green technology adoption among small and medium-sized enterprises (SMEs) in Bosnia and Herzegovina. The quantitative approach was adopted because it allows the objective measurement of relationships between research variables and provides an appropriate basis for statistical hypothesis testing. The comparative design also enabled an exploration of potential differences between SMEs operating in the Federation of Bosnia and Herzegovina (FBiH) and RS in relation to the adoption of green technologies and the growth of sustainable investments. The primary data was collected through a structured questionnaire which was developed based on the conceptual research model and the literature review presented in the master thesis. The questionnaire was divided into two parts. The first section collected demographic and organizational information, such as affiliation with an entity, industry, company size, years of operation, export orientation, and the proportion of exports to the European Union. The second section quantified the research constructs via close-ended statements rated on a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

The conceptual model comprised of six latent constructs namely Financial Capacity (FIN), Institutional Support (INST), Managerial Awareness (MAN), Perceived Benefits of Green Investments (PER), Green Adoption Level (GAL) and Sustainable Investment Growth (SIG). These constructs were operationalized through the use of multiple questionnaire items adapted from the theoretical framework and empirical literature on green transition and sustainable business development. The final sample consisted of 150 SMEs operating in Bosnia and Herzegovina. The respondents were owners, directors, managers and others directly involved in the strategic and investment decision making within their organizations. The online questionnaire was conducted via Google Forms, which allowed SMEs from different industries and geographical regions to participate, and thus standardized the data collection process.

The collected data were analyzed using IBM SPSS Statistics. Descriptive statistics, reliability analysis (Cronbach's Alpha), independent-samples t-test, Pearson correlation analysis, multiple linear regression analysis and multicollinearity diagnostics (Variance Inflation Factor, VIF) were used for the analysis. In the evaluation of the conceptual model and the empirical testing of the three research hypotheses formulated in this study, the statistical techniques were utilized.

3.2. RESULTS

3.2.1. CHARACTERISTICS OF THE SAMPLE

The research was based on a sample of 174 questionnaires received from small and medium enterprises (SMEs) in Bosnia and Herzegovina. Data screening was followed by listwise deletion of incomplete responses and statistical analysis of 150 valid questionnaires. The final sample consisted of owners, directors, managers and other staff members directly involved in strategic and investment decision making, so that the respondents had sufficient knowledge of the sustainability practices and investment activities of their firms. The participating enterprises were of different organizational profiles, i.e. entities of Bosnia and Herzegovina, different industry sectors, company sizes, years of operation, export orientation and levels of exports to the European Union. Thus, the heterogeneous sample was a good basis for investigating differences in the adoption of green technologies and growth of sustainable investment in different organizational and institutional contexts. Table 1 provides a summary of demographic and organizational characteristics of the participating enterprises.

Variable	Category	n	%
Entity	FBiH	75	50.0
	RS	75	50.0
Industry	Manufacturing	45	30.0
	Energy / Utilities	75	50.0
	Construction	15	10.0
	Services	8	5.mar
	Trade	7	4.jul
Company size	Micro (1–9 employees)	38	25.mar
	Small (10–49 employees)	75	50.0
	Medium (50–249 employees)	37	24.jul
Years in operation	11–20 years	75	50.0
	More than 20 years	75	50.0
Export orientation	Yes	75	50.0
	No	75	50.0
Share of revenue from EU exports	Less than 25%	38	50.7*
	25–50%	37	49.3*

TABLE 1-DESCRIPTION OF THE PARTICIPATING SMES

3.2.2. RELIABILITY EVALUATION

The internal consistency of the measurement scales was measured using Cronbach's Alpha coefficient. Values above 0.70 are considered acceptable reliability, while above 0.80 are considered good reliability and coefficients above 0.90 are considered excellent internal consistency (Hair et al., 2019). Before the hypothesis testing, reliability testing was conducted to ensure that all items in the questionnaire were measuring what they were supposed to measure and they did. Table 2 shows that all constructs were above the recommended threshold of 0.70. This shows that the measurement instrument achieved satisfactory reliability. Sustainable Investment Growth ($\alpha = 0.956$) had the best internal consistency and Financial Capacity ($\alpha = 0.720$) was acceptable. To summarize, the results showed that the measurement scales were sufficiently reliable for use in the subsequent correlation, regression and hypothesis testing analyses.

Construct	Number of Items	Cronbach's Alpha	Reliability
Financial Capacity (FIN)	4	0.720	Acceptable

Institutional Support (INST)	4	0.863	Good
Managerial Awareness (MAN)	4	0.812	Good
Perceived Benefits of Green Investments (PER)	4	0.901	Excellent
Sustainable Investment Growth (SIG)	6	0.956	Excellent

TABLE 2-RELIABILITY ANALYSES

3.2.3. DESCRIPTIVE STATISTICS

Prior to hypothesis testing, descriptive statistics were performed to give an overview of the central tendency and variability of the main constructs included in the research model. Financial Capacity (FIN) Institutional Support (INST) Managerial Awareness (MAN) Perceived Benefits of Green Investments (PER) Green Adoption Level (GAL) Sustainable Investment Growth (SIG). The results indicate that Sustainable Investment Growth (SIG) had the highest mean value ($M = 3.790$) showing positive perceptions of recent investment activities, business expansion and modernization reported by the surveyed SMEs. The second highest mean was found in Perceived Benefits of Green Investments (PER) ($M = 3.600$). It showed that the respondents were aware of the economic and strategic advantages of investing in green technologies. Managerial Awareness (MAN) also had a relatively high average ($M = 3.575$), indicating a satisfactory level of awareness among managers regarding sustainability, environmental regulations and the strategic importance of green transition.

In contrast, the lowest mean values were obtained for Financial Capacity (FIN) ($M = 2.691$) and Institutional Support (INST) ($M = 2.675$), indicating that financial constraints and lack of institutional support are the main barriers to the implementation of green transition projects in SMEs. The values of standard deviation ranged between 0.848 and 1.059. This shows that the respondents' perceptions varied moderately. The highest variation among the respondents was on Institutional Support with Financial Capacity being the most agreed factor. Descriptive statistics results generally indicate that SMEs in Bosnia and Herzegovina are aware of the importance and possible benefits of green investments and have a relatively high level of managerial awareness. But the results also show that the main barriers to increased adoption of green technologies are still financial constraints and lack of institutional support. The preliminary results are a precursor to the reliability, correlation, comparative and regression analyses in the subsequent sections.

3.2.4. INDEPENDENT SAMPLES T-TEST FOR COMPARING FBiH AND RS

An independent-samples t-test was used to test for statistically significant differences on the level of green technology adoption by SMEs operating in Federation of Bosnia and Herzegovina (FBiH) and those operating in Republika Srpska (RS). Before interpreting the results, the assumption of homogeneity of variance was checked by Levene's Test for Equality of Variances. The test was not statistically significant ($F=1.535$, $p=0.217$) showing that the assumption of equal variances was met. Interpretation was done for the results in the Equal variances assumed row.

There was a statistically significant difference between the two groups as determined by an independent-samples t-test ($t(148) = 8.312$, $p < .001$). SMEs in the Federation of Bosnia and Herzegovina ($M = 4.12$, $SD = 0.81$) adopted green technologies to a greater extent than SMEs in Republika Srpska ($M = 2.78$, $SD = 0.95$). The mean difference between the two groups was 1.336 (95% CI = 1.018–1.653), indicating a significant difference in the adoption of environmentally sustainable technologies and practices. The results show that SMEs in the Federation of Bosnia and Herzegovina have achieved a considerably higher level of green transition compared to companies in Republika Srpska. The difference is attributed to differences in institutional support, access to financial incentives, managerial awareness and exposure to European Union environmental requirements, especially in export-oriented firms. In contrast, SMEs in Republika Srpska appear to be more limited in the use of green technologies and this results in a lower level of adoption in general. The results empirically confirm the first research hypothesis in general and confirm the importance of institutional environment as a contextual factor impacting the adoption of green energy and technology by SMEs from Bosnia and Herzegovina.

Variable	FBiH (Mean ± SD)	RS (Mean ± SD)	t	p-value
Green Technology Adoption (SIG)	4.12 ± 0.81	2.78 ± 0.95	8.312	<0.001***

TABLE 3-T-TEST FOR INDEPENDENT SAMPLES

Note. Levene Test: F = 1.535, p =.217

3.2.5. CORRELATION ANALYSIS

Before estimating the simultaneous effects by the multiple regression analysis, the relationships among the main constructs included in the conceptual research model were explored by the Pearson's correlation analysis. The analysis investigated the size and direction of the linear relationships between Financial Capacity (FIN), Institutional Support (INST), Managerial Awareness (MAN), Perceived Benefits of Green Investments (PER), and Sustainable Investment Growth (SIG). The results give an initial assessment of the relationship between the independent variables and the growth of sustainable investments and therefore the rationale for their inclusion in the subsequent regression model. The results indicated a positive and significant relationship of all independent variables with Sustainable Investment Growth (SIG). This implies that the higher the level of organizational resources and better institutional conditions, the better the green transition outcomes in SMEs. The strongest correlation was between the MAN and the SIG ($r = .758$, $p < .001$). Therefore, companies with managers with more sustainability orientation and higher level of commitment to environmental practices are much more likely to achieve higher levels of green technology adoption and sustainable investment growth.

Also, a significant positive correlation was found between the Perceived Benefits of Green Investments (PER) and Sustainable Investment Growth (SIG) ($r = 0.612$, $p < 0.001$). This result suggests a growing awareness of the economic and strategic benefits of green investments by SMEs and, therefore, a greater likelihood of adopting renewable energy solutions and environmentally sustainable technologies. Furthermore, when considering Institutional Support (INST), a statistically significant positive link with Sustainable Investment Growth ($r = 0.514$, $p < 0.001$) was found suggesting that government incentives, administrative support and favorable institutional frameworks are contributing positively to the implementation of green technologies, although their effect seems to be lower than the managerial ones. The lowest but significant correlation between Financial Capacity (FIN) and Sustainable Investment Growth (SIG) ($r = 0.211$, $p = 0.005$). Financial means exist for investing in sustainable technologies. However, the low correlation coefficient indicates that the financial capacity does not explain the variation of SMEs' green transition. Financial resources appear to work better in combination with managerial commitment and favorable institutional conditions. The analysis also indicated interrelation of independent variables positively at statistically significant levels. The highest intercorrelation was between Managerial Awareness and Institutional Support ($r = 0.697$) and Financial Capacity and Institutional Support ($r = 0.634$). The coefficients suggest moderate to high relationships between the explanatory variables, but they are below the generally accepted thresholds indicating problematic multicollinearity. Hence, the correlation analysis confirms that the variables are correlated sufficiently to support the proposed conceptual model, without impairing the validity of the subsequent multiple regression analysis.

3.2.6. MULTIVARIATE REGRESSION MODELS

Multiple linear regression analysis was employed in determining the key determinants of sustainable investment growth of SMEs in Bosnia and Herzegovina. Dependent Variable: Sustainable Investment Growth (SIG) Independent Variables: Financial Capacity (FIN) Institutional Support (INST) Managerial Awareness (MAN) Perceived Benefits of Green Investments (PER) The assumptions of multiple regression were examined before the regression model was estimated. The multicollinearity diagnostics with Tolerance and Variance Inflation Factor (VIF) confirmed that all predictors were within the acceptable thresholds, therefore the independent variables were measuring different dimensions of the green transition process, and the estimated coefficients could be reliably interpreted.

The regression model was statistically significant ($F = 69.651$, $p < 0.001$), and accounted for 65.8% of the variance in Sustainable Investment Growth ($R^2 = 0.658$). The level of explanatory power shows that the selected determinants explain the growth of sustainable investment in SMEs in Bosnia and Herzegovina well.

The regression coefficients indicated that Managerial Awareness was the strongest predictor of Sustainable Investment Growth ($\beta = 0.618$, $p < 0.001$), followed by Perceived Benefits of Green Investments ($\beta = 0.331$, $p < 0.001$). The results show that the probability of higher levels of growth of sustainable investments is significantly higher for SMEs with a higher level of manager awareness of sustainability issues, as well as a perception of strategic and economic benefits from green investments. The findings underscore the importance of internal organizational capabilities in driving the green transition.

However, Financial Capacity ($p = 0.464$) and Institutional Support ($p = 0.952$) did not show a statistically significant independent effect controlling for the other variables. Both variables correlated positively with the growth of sustainable investment in the correlation analysis, but they were not significant in the multivariate model, so their impact is more indirect in nature, mediated by managerial decision-making and the perception of the strategic value of green investment rather than direct predictors.

Overall, the regression analysis suggests that the development of sustainable investment in SMEs is mainly influenced by internal managerial capabilities rather than only external financial and institutional factors. The results confirm the Resource-Based View, stating that the most important determinants of sustainable competitiveness and successful green transition are intangible organizational resources, especially managerial knowledge, strategic commitment, and the ability to identify opportunities connected with sustainable investments.

3.2.7. EXPERIMENTAL TEST OF THE HYPOTHESIS

The proposed research hypotheses were tested using the empirical results of independent-samples t-test, Pearson correlation analysis and multiple linear regression analysis. Differences between SMEs operating in Federation of Bosnia and Herzegovina (FBiH) and Republika Srpska (RS) were examined using the independent-samples t-test. Pearson correlation and multiple regression analyses were used to determine the relationship between determinants of green transition and sustainable investment growth. The level of significance for statistical significance was 5% ($p < 0.05$). The results offer enough evidence to support the proposed conceptual framework. **The first hypothesis (H1) was accepted.** The independent-samples t-test revealed a statistically significant difference in the level of green technology adoption between SMEs operating in FBiH and those operating in RS ($t = 8.312$, $p < 0.001$). However, results from the Federation of Bosnia and Herzegovina show much higher levels of adoption of green technologies by SMEs, confirming the importance of the institutional environment in shaping sustainable business practices. **The hypothesis H2 was not verified;** While it is assumed that SMEs from the two entities have different perceptions regarding the determinants of green transition, the empirical evidence did not show statistically significant differences in terms of perceived impact of CBAM-related pressures. The findings indicate that export-oriented SMEs in Bosnia and Herzegovina are subject to similar market and regulatory expectations associated with the European Union's Carbon Border Adjustment Mechanism regardless of the administrative jurisdiction in which they operate. **Supported the third hypothesis (H3).** The results of regression analysis showed that green technology adoption has positive effect on growth of sustainable investment of SMEs. Specifically, Managerial Awareness and Perceived Benefits of Green Investments were statistically significant predictors, while Financial Capacity and Institutional Support did not have statistically significant independent effects when other variables were controlled for. Our findings suggest that the key determinants of growth in sustainable investments are not always financial or institutional factors per se, but the internal managerial capacity and strategic awareness of the long-term benefits of green investments.

The overall results confirm the success of the proposed conceptual model in explaining the process of green transition in the case of SMEs in Bosnia and Herzegovina. Institutional differences result in different levels of green technology adoption between the two entities. However, the long-term expansion of sustainable investment is mostly a matter of managerial commitment and the effective use of internal organizational capabilities.

Hypothesis	Result
H1: There is a statistically significant difference in the use of green energy and technology between SMEs in FBiH and SMEs in RS.	Accepted

H2: SMEs operating in the Federation of Bosnia and Herzegovina and Republika Srpska have different perceptions of the determinants of green transition.	Rejected
H3: Green technology adoption positively influences sustainable investment growth among SMEs, with the strength of this relationship differing between the two entities.	Accepted

TABLE 4-HYPOTHESIS RESULT

4. PRACTICAL IMPLEMENTATION

The results of this research have several practical implications for SME managers, policy makers and business support organizations involved in the promotion of sustainable development and greening transition in Bosnia and Herzegovina. The first results indicate that managerial awareness is the most important determinant of growth in sustainable investment. This finding indicates that the successful adoption of green technologies is not only dependent on financial resources, but also on managers' ability to perceive sustainability as a strategic business opportunity. For this reason, SME owners and managers should further develop their knowledge of environmental regulations, renewable energy solutions, energy efficiency measures and long-term sustainability strategies through continuous professional development and training. Development of managerial competencies can greatly increase the probability of successful green transformation and improve the long-term competitiveness of firms.

Second, the strong effect of perceived benefits of green investments points to the importance of showing the economic value of sustainable business practices. The more managers recognize the potential of green technologies to reduce operating costs, improve productivity, enhance competitiveness and facilitate access to international markets, the more they are inclined to invest in those technologies in SMEs. Therefore, awareness-raising, sharing practical case studies and disseminating instances of effective implementation can lead to a wider adoption of green technologies among SMEs. The results also suggest that financial capacity and institutional support are positively associated with sustainable investment growth, but do not independently predict investment performance when managerial factors are considered at the same time. Thus, financial incentives may not be sufficient to accelerate the green transition. Therefore, public support programs should include a combination of financial assistance and advisory services, technical support, managerial training and capacity-building activities to enable SMEs to implement sustainable technologies effectively.

Furthermore, the uncovered disparities between SMEs in the Federation of Bosnia and Herzegovina and Republika Srpska imply that policymakers need to think about regional institutional characteristics when developing green transition policies. Better coordination between institutions, more streamlined administrative procedures, easier access to financial support programs and consistent regulatory guidance could help lower the barriers to green technology adoption for both entities. Finally, the rise of the importance of the EU's environmental policies, especially the Carbon Border Adjustment Mechanism (CBAM), puts forward the idea of export-oriented SMEs being proactive in terms of sustainability. Early investment in renewable energy and energy-efficient production technologies and environmental management systems can enhance regulatory compliance, increase competitiveness within European supply chains and reduce long-term business risks from increasingly stringent environmental standards. To summarize, the results emphasize the need for an integrated approach to a successful green transition, requiring managerial capabilities, organizational commitment and supportive institutional policies. Improvement of these aspects will help SMEs in Bosnia and Herzegovina to speed up the adoption of green technologies, while improving their long-term sustainability and investment performance.

5. CONCLUSION

The objective of this study was to examine the determinants of green technology adoption and the impact of green technology adoption on sustainable investment growth in SMEs in Bosnia and Herzegovina. The paper, using a quantitative research design and empirical data collected from 150 SMEs, investigated the roles of financial capacity, institutional support, managerial awareness and perceived benefits of green investments and compared enterprises operating in the Federation of Bosnia and Herzegovina and Republika Srpska. The results indicate that there are significant differences between the two in the extent of green technology adoption, which supports the importance of the institutional environment in shaping sustainable business practices. The regression analysis also

showed that managerial awareness and perceived benefits of green investments are the strongest determinants of the growth of sustainable investments, whereas financial capacity and institutional support did not show statistically significant independent effects after controlling for the other variables. These results suggest that the success of the green transition depends not only on the availability of financial resources, but also on the ability of managers to perceive sustainability as a strategic opportunity and to integrate environmental considerations into business decision-making. The results theoretically support both the Resource-Based View and Institutional Theory, since they show that internal organizational capabilities and external institutional conditions jointly affect the adoption of green technologies. At the same time, the results highlight that intangible organizational resources, especially managerial knowledge and strategic commitment, are more decisive for the promotion of sustainable investment growth than financial resources alone. The results are also relevant for managers and policy makers. Improving managerial competencies, raising awareness of the economic benefits of green investments, simplifying access to institutional support and encouraging early adaptation to European environmental regulations can significantly accelerate the green transition of SMEs in Bosnia and Herzegovina. Despite these contributions, the present study has several limitations. The analysis is based on a cross-sectional dataset from SMEs in Bosnia and Herzegovina, which limits the generalization of the results to other countries and prevents observing changes over time. Future research could adopt longitudinal designs, incorporate additional organizational and environmental variables, and perform comparative analyses of the Western Balkan countries, providing a broader view of the drivers of green technology adoption and sustainable business development.

6. REFERENCES

1. Aragón-Correa, J. A., Hurtado-Torres, N., Sharma, S., & García-Morales, V. J. (2008). Environmental Strategy and Performance in Small Firms: A Resource-Based Perspective. *Journal of Environmental Management*, 103.
2. Aras, G., & Crowther, D. (2012). *Business Strategy and Sustainability: Economic, Management, and Governance Issues*. Bingley: Emerald Group Publishing Limited.
3. Bansal, P. (2003). From Issues to Actions: The Importance of Individual Concerns and Organizational Values in Responding to Natural Environmental Issues. *Organization Science*, 527.
4. Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 120.
5. Borjo, D., Yushi, J., Hongyu, Z., Xiao, L., & Miao, M. (2023). A pathway to the green revolution in emerging economies: how does green technological innovation affect green growth and ecological sustainability? *Routledge Taylor & Francis Online*, 23.
6. Commission, E. (2021). *Proposal for a Regulation of the European Parliament and of the Council establishing a Carbon Border Adjustment Mechanism*. Brussels: European Commission.
7. Commission, European. (2024). *Annual Report on European SMEs 2023/2024*. Luxembourg: Publications Office of the European Union.
8. Del Río, P., Peñasco, C., & Romero, J. D. (2016). What Drives Eco-Innovators? A Critical Review of the Empirical Literature Based on Econometric Methods. *Journal of Cleaner Production*, 2170.
9. DiMaggio, P. J., & Powell, W. W. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, 160.
10. Elkington, J. (1997). *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Oxford: Capstone Publishing.
11. European Commission. (2003). *Commission Recommendation 2003/361/EC of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises*. Brussels: Official Journal of the European Union.
12. European Commission. (2019). *The European Green Deal*. Brussels: Publications Office of the European Union.
13. European Commission. (2021). *Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism (COM(2021) 564 final)*. Brussels: European Commission.
14. European Commission. (2024). *Annual Report on European SMEs 2023/2024: SME Performance Review*. Luxembourg: Publications Office of the European Union.
15. European Court of Auditors. (2022). *Special Report 08/2022: ERDF Support for SME Competitiveness – Design Shortcomings Decrease the Effectiveness of Funding*. Luxembourg: Publications Office of the European Union.
16. European Investment Bank. (2023). *EIB Investment Survey 2023: European Union Overview*. Luxembourg: European Investment Bank.
17. Foreign Trade Chamber of Bosnia and Herzegovina. (2024). *Green transition in BiH-with specific reference to carbon footprint taxation*. Sarajevo: Foreign Trade Chamber of Bosnia and Herzegovina.
18. Friede, G., Busch, T., & Bassen, A. (2015). ESG and Financial Performance: Aggregated Evidence from More Than 2000 Empirical Studies. *Journal of Sustainable Finance & Investment*, 233.
19. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate Data Analysis*. Andover, Hampshire: Cengage Learning.
20. Hermundsdottir, F., & Aspelund, A. (2022). Competitive sustainable manufacturing - Sustainability strategies, environmental and social innovations, and their effects on firm performance. *Journal of Cleaner Production*, 11.
21. Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of Eco-Innovations by Type of Environmental Impact: The Role of Regulatory Push/Pull, Technology Push and Market Pull. *Ecological Economics*, 122.
22. Li, M., Sun, Y., Xia, Y., Yang, Z., Chen, C., Yuan, Y., & Wang, P. (2026). The impacts of Carbon Border Adjustment Mechanism (CBAM) on international trade and policy responses: from an economic and environmental equity perspective. *Energy Policy*, 17.
23. OECD. (2023). *OECD SME and Entrepreneurship Outlook 2023*. Paris: OECD Publishing.
24. Porter, M. E., & van der Linde, C. (1995). Toward a New Conception of the Environment-Competitiveness Relationship. *Journal of Economic Perspectives*, 118.
25. Rogers, E. M. (2003). *Diffusion of Innovations*. New York: Free Press.
26. United Nations. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York: United Nations.
27. Vadrucio, R., Scarpino, C., & Tumino, A. (2025). Unveiling Industrial Internet of Things potential for sustainable manufacturing: a Triple Bottom Line approach. *Procedia Computer Science*, 9.
28. World Bank. (2023). *Small and Medium Enterprises (SMEs) Finance*. Washington, DC: World Bank.

29. World Bank. (2023). *Small and Medium Enterprises (SMEs) Finance*. Washington, DC: World Bank.
30. World Commission on Environment and Development. (1987). *Our Common Future*. Oxford : Oxford University Press.