

CROSS-BORDER ENTREPRENEURSHIP: SEIZING OPPORTUNITIES IN THE EUROPEAN UNION'S DIGITAL AND GREEN TRANSITION

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Abstract

The article analyzes how existing or newly established companies can integrate into the transformations emerging from new climate change regulations and digitalization processes through the lens of cross-border entrepreneurship. Within the framework of the European Union's green transition regulations, it examines the European Green Deal (EGD), the Carbon Border Adjustment Mechanism (CBAM), the Emission Trading System (ETS), digital market strategies, and circular economy policies. The impacts of carbon pricing, renewable energy investments, green finance instruments, and sustainable economy strategies on businesses are evaluated alongside the digital transformation dimension, focusing on the Internet of Things (IoT), blockchain technology, e-commerce, and e-export. The central emphasis of the study is to demonstrate that, despite the presence of elements that initially increase costs and create compliance challenges, EU practices can be transformed into advantages in global market competition through an innovation-oriented approach. In particular, access to EU funds, sustainable production, and digital supply chain management stand out as factors that facilitate the adaptation of businesses to new markets. The study emphasizes that regulatory practices are not merely an obligation but a strategy for keeping pace with an evolving and changing world. It argues that institutions adopting these strategies can benefit from green transition and digital ecosystems, while contributing to the literature by establishing a link between policymakers and cross-border entrepreneurs. In order to realize the twin transition, facilitating access to finance, strengthening digital infrastructure, and ensuring compliance with regulatory frameworks emerge as key factors supporting SMEs' integration into cross-border markets. It provides a conceptual and policy-oriented perspective on how the EU's twin transition can reshape international business models and create new opportunity areas for sustainable and digital entrepreneurship.

Keywords: Digital transformation, entrepreneurship, EU, green transition, innovation.

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1. Introduction

The consequences of climate change are visibly manifesting worldwide. Consequently, the global fight against climate change is being reshaped through digitalization processes across economic, political, and strategic axes. The EU, as a pioneer in climate action, addresses this transformation through the Twin Transition approach, namely the green and digital transitions. Both transformations are viewed as interconnected, complementary processes that must be sustained simultaneously. While aiming for climate neutrality by 2050 with the European Green Deal (EGD), the Union is also building a technology-based economic structure through the digital single market strategy.

This study examines the advantages offered by the new regulations introduced by the EU through the perspective of cross-border entrepreneurship. By adapting to the green and digital transitions, it will be possible to maintain competitiveness in both the Union market and the global market. Consequently, it seeks to answer the question of how entrepreneurs can integrate into the global market through the twin transition and how they can turn competitiveness into an advantage by complying with new regulations during the transformation phase. Within the framework of this main question, the following sub-questions are explored:

- How do regulations such as the Green Deal and CBAM transform the production and export strategies of firms?
- How do digitalization tools facilitate cross-border activities?
- Does the regulatory compliance process increase innovation capacity?

The article demonstrates that integration into regulatory applications should be evaluated not as a passive requirement but as a strategic opportunity.

This study is based on the qualitative research method. European Commission reports, EU legislative texts, policy documents, and academic studies were utilized as data sources for the article. The primary reference points of the study consist of official documents regarding the EGD, the CBAM Regulation, digital transformation policies, and financing and grant programs. The evaluation framework of the study is constructed upon the PESTEL analysis, which systematically examines the transformation through its Political, Economic, Social, Technological, Environmental, and Legal dimensions.

The second section of the study evaluates CBAM, circular economy ventures, and renewable energy within the framework of green transition and sustainability opportunities. The third section examines digital transformation and technological adaptation, focusing on the digital single market and standards, digitalization in industry, e-commerce, and entrepreneurship. The fourth section details EU innovation funds and green finance mechanisms under the heading of financing and ecosystem supports. The fifth section

discusses the risks and challenges faced by entrepreneurial firms in local ecosystems. Finally, the sixth section concludes the study by summarizing the findings and policy implications.

2. Green Transition and Sustainability Opportunities

Climate change is evolving every year. This change is global and does not remain confined within national borders. In the context of combating climate change and seeking solutions to environmental problems, the Union has introduced the European Green Deal (EGD). One million of the eight million species on the planet are facing the threat of extinction. The atmosphere is warming, while forests and oceans are being polluted. The Green Deal serves as a solution to these challenges. It emerges as a growth strategy aiming to transform the Union into a more prosperous and fair society. The Deal targets zero emission rates by 2050, the transition to a circular economy, decoupling economic growth from resource use, and achieving a nature-friendly, resource-efficient economy (European Commission, 2019).

During the long-term implementation processes of the Green Deal, both geopolitical and political developments have created certain challenges in the establishment of both Union-wide and national policies. The first test faced by the Deal was Covid-19. Due to the economic contractions brought by the pandemic, the Deal lost political priority, and the implementation of some policies was postponed. However, the timeline for the fundamental targets regarding the climate crisis was maintained (Siddi, 2020, pp. 8–9).

New regulations brought by the green transition, such as the Carbon Border Adjustment Mechanism (CBAM) and the Emission Trading System (ETS), indirectly affect not only member states but also other countries outside the Union.

2.1. Carbon Border Adjustment Mechanism

CBAM was introduced to prevent carbon leakage in achieving the Union's climate targets and has become a next-generation tax established to protect competition between its own market products and imported goods, ensuring fair carbon pricing. The system covers emissions resulting from the production of imported goods and aims to direct the industry toward investments in decarbonization in production. CBAM was initially envisioned for emission-intensive sectors with a high risk of carbon leakage, such as iron and steel, fertilizers, aluminum, electricity, and hydrogen. It is planned to expand these sectors over time. The rules introduced by the system are compatible with the World Trade Organization. It aims to encourage developing countries to adopt production technologies with lower emissions. CBAM is implemented through regulatory and administrative tools such as declaration obligations, certificate pricing, and verification processes (European Union, 2023).

The high carbon prices accompanying CBAM increase costs, particularly in the field of electricity. This situation affects not only the industry but also households. Sub-producers

using the intermediate goods of sectors within the scope of the system face both rising prices of their resources and the carbon costs that must be paid for imported products. Through CBAM, the Union intends to protect its internal market power (Bellora & Fontagné, 2022, pp. 22-23).

Those expected to be most affected by the system are the regional and neighboring countries that export the most to the Union. Russia, Türkiye, and Ukraine are at the forefront of these. On the other hand, Egypt, Morocco, Algeria, North African countries, and Eastern European countries follow (European Commission, 2021).

CBAM is not merely a trade tool intended to prevent carbon leakage; it is also positioned as a significant law of global trade. Rather than exerting regulatory pressure on countries, it carries the potential for a different transformation. Through new formations such as climate clubs, it mandates cross-border entrepreneurs to integrate into a sustainable and clean production process (Mehling et al., 2022, p. 213).

2.2. Circular Economy Ventures

The most important economic growth strategy brought by the green transition has been the transition from a linear model to a circular economy. The traditional linear economic model was based on the "take, make, dispose" approach, assuming that resources were unlimited. The priority was the increase in productivity. The circular economy, by its nature, aims at restoration. Products must be designed to re-enter technical and biological cycles. Furthermore, it prioritizes resilience over the efficiency system. All stages of production must be provided by renewable resources. This includes human labor as well. In the service-oriented model of the circular economy, where ownership of the product remains with the producer and the consumer is seen only as a user, products support a system that is more durable, repairable, and continuously usable instead of being consumed (Ellen MacArthur Foundation, 2015, pp. 21-23).

To implement the circular economy, actions must be carried out in every field, from social to technological and from technological to commercial. It is the responsibility of states to introduce reusable products and to produce the necessary policies and strategies for this purpose. In this sense, it is of great importance to educate both consumers and producers with this awareness and to increase sensitivity. There is a need to support actions such as clothing rentals and jewelry sharing. Policy makers should support change by imposing a tax burden on the consumption of non-renewable resources—including human labor—rather than focusing on renewable resources. Growth should be measured and determined by stock and capital. For instance, by renovating old buildings, the stock quality of the buildings increases and energy savings are achieved (Stahel, 2016, pp. 436-437).

In the context of environmental protection and the climate struggle, most states in the world view this task as an individual duty. In addition to this, they produce environmental

policies and entrust the responsibility of protecting the natural balance to the constitution. Some constitutions even prioritize environmental elements over many rights. For example, they can limit property rights in favor of environmental policies. As seen in the Chilean constitution, restrictions can be imposed on the use of certain rights to protect nature (United Nations Environment Programme, 2018, p. 22).

While approximately 100 billion tons of material are consumed annually in the world, only 8.6% of this is recycled. Consequently, this situation leads to the depletion of resources, increased emissions, and environmental degradation. The new applications introduced by the EU within the scope of climate change force companies globally to radically change their production stages. The importance of redesign is immense in the stages of transitioning to a circular economy. The durability, quality, functionality, and environmental performance of the product are at the forefront of the design. Extending the life cycle of the product, having repairability features, and managing end-of-life to re-evaluate the product through recycling are considered important strategies (Favi & Marconi, 2025, p. 2).

2.3. Renewable Energy and Efficiency

The most significant obstacle to the implementation of renewable energy, one of the most vital elements of the climate struggle, has been the cost of capital. Unlike fossil fuels, the establishment of renewable energy systems requires large initial investments. Therefore, high costs slow down the use and development of clean energy technologies. On the other hand, advances in technology are reducing the costs of using solar and wind energy. Energy efficiency is being increased with necessary storage technologies, smart grids, and lithium-ion batteries. In addition to these, the risk perception of investors is influential. To reduce costs and lower the risk level, green finance and Blended Finance structures stand out. While green finance provides green bonds and loans, it offers long-term opportunities with lower interest rates as it considers sustainable projects less risky. Blended Finance is defined as a method where government and private sector stakeholders share risks to reduce costs. Policy structures are accepted as driving forces that increase investments, such as tax exemptions, subsidies, and energy efficiency codes. Renewable energy is also seen as a source of employment. While the establishment, maintenance, and manufacturing processes of the system contribute to the economy as new areas of employment, they also allow for the reduction of emission rates and the protection of natural resources from an environmental perspective (Yang, Zhou & Gao, 2025, pp. 1-4).

With the use of renewable energy systems, not only do governments and the private sector produce energy, but consumers also assume a "prosumer" identity, producing their own energy. While the most important factor in efficiency in traditional energy consumption was the preference for the low-cost option, this situation has changed in renewable energy systems. This paradigm has shifted, especially with the decrease in the costs of energy

obtained through solar and wind. In the last decade, there has been an 81% decrease in photovoltaic system costs and a 34% decrease in wind energy system costs. Regarding implementation constraints, it is recommended that commercial organizations and energy companies do not focus solely on efficiency but evaluate the relationship between supply and demand holistically (Senatla Jaane et al., 2024, pp. 1-18).

3. Digital Transformation and Technological Adaptation

Digital transformation is described as the integration process of elements such as labor, technology, strategy, and culture in the development of existing products and services. Although technology advances very rapidly, the pace at which organizations adapt cannot be as fast as that of individuals. Even when organizations are inclined to adopt new technologies, the alignment of their operations with this process can take time. For organizations, adopting technology is not merely about technical implementation; it is also crucial that it is accepted and integrated into daily activities. Especially for SMEs (Small and Medium-Sized Enterprises) in developing countries, individual acceptability within the institution plays a vital role in converting technology into productivity. Challenges such as lower or middle-income levels, low digital literacy, and limited infrastructure in developing countries hinder digital transformation. However, through digital transformation, developing countries can leapfrog industrialization stages, gaining direct access to education, healthcare, and finance, and acquiring a structure sensitive to socio-cultural dynamics by participating in the global chain (Díaz-Arancibia et al., 2024, pp. 2-4).

3.1. Digital Single Market and Standards

With the emergence of Bitcoin in 2008, blockchain technology entered our lives as a revolutionary development allowing secure data storage without a central authority. The immutability feature of blockchain technology creates conflicts with the EU General Data Protection Regulation (GDPR), which came into force in 2018, on three main points. First, the GDPR's "Right to be Forgotten" grants individuals the right to have their data deleted, whereas the permanent and immutable storage of data in blockchain systems makes the exercise of this right impossible. Second is the determination of responsibilities; the GDPR clearly defines roles such as data processors and data controllers. However, in a blockchain network, it is unclear who controls the data and who is legally responsible. Finally, there is the possibility of data crossing borders. Since a copy of public data is kept on the blockchain network and nodes can be located anywhere in the world outside the EU, a violation regarding the cross-border transfer of data may occur (Belen-Sağlam et al., 2022, pp. 2-5).

3.2. Digitalization in Industry

Blockchain technology, with its features of transparency, traceability, and data integrity, has taken its place as a digital ledger that eliminates the need for auditors. This situation has provided various advantages to the increasingly complex supply chain. The

advantage of transparency and trust lies in maintaining a record of the process from the source of assets to the final stage of delivery. Another advantage is the reduction of costs by eliminating third-party verifiers and intermediaries. While ensuring timely access to data for all participants in chain management, it proves that products are original and prevents unauthorized access to the system. Internet of Things (IoT) technology emerges as an infrastructure that allows physical products to interact with each other over the internet through tools such as smart devices and sensors. In trade, it facilitates the tracking of products by being used to monitor logistics and production stages. The use of these technologies enables businesses to expand into the supply chain by carrying them across borders (Taşcı & Güzel, 2023, pp. 412-416). Besides the advantages of blockchain technology, there are difficulties and barriers in its implementation. Structural issues such as data fragmentation, different protocol regulations, and the lack of information resources appear as implementation challenges. Furthermore, the high costs of transforming existing systems, the inability of the technology to harmonize with current systems, and the presence of different partners increase complexity in international networks. Due to the legal uncertainties of the technology, commercial security and official recognition become difficult (Karagenç & Dedeoğlu, 2025, pp. 164-165).

3.3. E-Commerce and Digital Entrepreneurship

In the global arena, blockchain, artificial intelligence, and cloud computing technologies have taken their place as driving forces of the digital economy. While these technologies increase production efficiency and decision-making quality, risks such as R&D costs and easy imitability prevent businesses from taking necessary steps in innovation (Chen et al., 2024, pp. 1-3). These developments in the technological field enable businesses to participate independently in the global market across borders. Through e-commerce, businesses utilize an extensive infrastructure to conduct economic transactions over internet platforms. With e-export, orders placed by consumers in different countries via digital channels ensure the delivery of products outside geographical borders. Micro-export facilitates the entry of SMEs into the global trade arena as a faster and lower-cost shipping method via the Simplified Customs Declaration for transactions not exceeding a gross weight of 300 kg and a value of 15,000 Euros. Transitioning from traditional export to e-export makes it possible to reduce transaction costs, accelerate customer feedback, and perform digital tracking of the supply chain (Tüfenk, 2024, pp. 5-8).

4. Financing and Ecosystem Supports

In order to comply with the EU's twin transition policies, sustainable financing mechanisms are required for entrepreneurs. Within this scope, the integration of SMEs into cross-border markets and the support of innovative projects are facilitated through EU innovation funds and green finance instruments.

4.1. EU Innovation Funds

Horizon Europe, one of the Union's innovation supports, is among the most important financing programs for innovation. A budget of 93.5 billion Euros is envisioned for the 2021-2027 period. The program supports the dissemination of information technologies by strengthening the impact of research and innovation and facilitating cooperation to support, develop, and implement EU policies while combating climate change. While increasing employment, the program supports the EU's economic growth and enhances its competitiveness (European Commission, 2026). Another financing program, the European Innovation Council (EIC) Accelerator, is a funding source under Horizon Europe that provides support to SMEs and startups meeting specific criteria. These criteria include having a groundbreaking new product or service model capable of disrupting the global market and targeting significant growth (European Innovation Council, 2026).

4.2. Green Finance

Green finance involves supporting sustainable investments with low-interest loans, whereas sustainable finance is a concept that encompasses social values and corporate governance principles alongside environmental values. Environmental finance accepts environmental damage as a financial risk and prioritizes the protection of the ecosystem. Carbon finance is a funding program designed to support projects aimed at reducing emission gas rates. Climate finance holds its place among support programs and grants as financing that supports activities for combating climate change. The main objectives of green finance are the mitigation of climate change, the protection of water and marine resources, the strengthening of the circular economy, the preservation of nature and biodiversity, and the alignment of financial mechanisms with green growth policies (Yilmazcan, 2025, pp. 708-715). The EU's green loans are not merely investment products but the most important financing tools for supporting sustainable projects. For a loan to be classified as green, it is expected to fulfill principles set by the Loan Market Association, such as utilizing funds in projects with environmental benefits, analyzing the borrower's social risks, ensuring funds are used in line with objectives, and verifying the impact of investments with quantitative data. According to 2021 data from the European Banking Authority, the green asset ratio of EU banks stands at 7.9%. To make sustainability a corporate necessity, the Corporate Sustainability Reporting Directive (CSRD) has been implemented. This directive mandates that companies report on environmental, social, and governance (ESG) factors (Lapinskiene et al., 2025, pp. 2-5).

5. Discussion: Risks and Challenges for Entrepreneurial Firms

The bureaucratic obstacles during the establishment phase of small businesses force entrepreneurs who wish to start a new venture to struggle with local regulations, such as complex paperwork, high costs, and long waiting periods. Due to factors like a lack of transparency and insufficient guidance, this situation either discourages starting a business or directs entrepreneurs toward the informal economy. Removing these barriers would allow

new entrepreneurs to establish themselves without being hindered by legal legislation and regulators, thereby enabling economic revitalization (Institute for Justice, 2026).

The tendency of new entrepreneurship to lean toward traditional agriculture and trade sectors limits economic diversity while affecting the development of market perception. Additionally, the difficulties new entrepreneurs face in accessing financial resources are among the significant obstacles. If the entrepreneurship ecosystem in a region is not supportive, it causes entrepreneurs to migrate to different regions (Morales et al., 2022, pp. 6–8). The growth of established businesses depends on local ecosystems shaped by infrastructure, financing, technology, and skills. While institutions develop through intermediaries such as university collaborations and local clusters, they continue their activities within the legal framework. National rules directly affect the establishment of businesses at the local level; for instance, the speed of obtaining licenses and land use are among these reasons. The impact on businesses located in cities versus rural areas also occurs at different levels. Companies in rural areas face challenges due to limited resources and access to expert support. With an innovative approach and digitalization, platforms that centralize the establishment, licensing, and registration processes of companies, along with the presence of digital government services, ensure that data is entered between institutions without duplication. This particularly reduces costs for companies in rural areas. All of these factors—simplifying and digitalizing regulatory stages—limit the discretionary authority of officials, thereby allowing for a reduction in corruption (OECD, 2025).

6. Conclusion

The new regulations introduced by the EU in the fight against climate change act as steps of a transformation that are effective at a global level, sometimes indirectly and sometimes directly. In this context, twin transition policies also bring regulatory obligations for companies. Although fulfilling these obligations may initially cause high costs, it will later manifest as an advantage. In the medium and long term, these transformation steps involving sustainable production, reduction of emission levels, and the circular economy will ensure the preservation of competitiveness in the international arena. The linear economy approach of traditional production models will have no place in the new world market. While the Green Deal sets the conditions for the climate struggle, it simultaneously encourages organizations toward eco-friendly business models through green finance and renewable energy strategies.

During the integration process of businesses into digital transformation, certain duties fall upon policymakers. It is particularly important to facilitate access to green finance and loans and to further strengthen technical compliance support mechanisms for enterprises such as SMEs.

The digital component of the twin transition facilitates cross-border trade. Through applications such as blockchain, IoT, e-commerce, and e-export, it provides easy access to

and storage of data, supply chain transparency, and operational efficiency. However, these applications also have negative aspects, such as data protection concerns, legal uncertainties, and technical compliance issues.

The EU supports the innovation capacity of companies in terms of financing through the Horizon and EIC programs. Consequently, green loans and financing help reduce transformation costs. Nevertheless, companies still face difficulties such as bureaucratic hurdles, changes in local ecosystems, and problems accessing green finance.

In conclusion, it is evident that integrating into EU practices is the most important element for maintaining competitiveness and not falling behind in trade in both the European and global markets. Companies must carry out a holistic transformation—from production and technology to governance and finance—in accordance with regulations. By increasing their innovation capacities and ensuring the integration process, entrepreneurs hold the potential to turn the transformation stages into a competitive advantage.

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