DIGITAL TRADE AS A CATALYST FOR GREEN ECONOMY TRANSFORMATION

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The transition to a green economy, emphasizing environmental sustainability alongside economic growth, necessitates the exploration of innovative tools and approaches. Digital trade, with its capacity to optimize resource allocation, enhance transparency, and foster new business models, emerges as a significant catalyst in this transformation. This paper examines the multifaceted role of digital trade in promoting green economic development. It analyzes how digital platforms and technologies facilitate more efficient supply chains, reduce waste, and enable the trade of environmentally friendly goods and services. Furthermore, the study explores the potential of digital solutions in enhancing environmental monitoring, promoting sustainable consumption patterns, and supporting the growth of circular economy initiatives. The analysis draws upon recent research and real-world examples to illustrate the tangible impacts of digital trade on ecological sustainability and economic efficiency. Key findings highlight the importance of supportive regulatory frameworks and technological infrastructure in harnessing the full potential of digital trade for greening the economy. The paper concludes by emphasizing the need for further research and policy interventions to maximize the synergistic relationship between digital commerce and environmental stewardship, paving the way for a more sustainable and resilient economic future.

Keywords: digital trade, green economy, sustainable development, e-commerce, environmental sustainability

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Introduction

The imperative for a global transition towards a green economy, characterized by sustainable resource management and reduced environmental impact, is increasingly urgent. In this context, the digital economy presents novel avenues for fostering economic growth while mitigating ecological risks. This study focuses on the role of digital trade, a rapidly expanding domain, as a potential driver for green economic transformation. While e-commerce has traditionally been analyzed through the lens of economic efficiency and market access, its implications for environmental sustainability warrant deeper investigation. This paper aims to explore the mechanisms through which digital trade can catalyze the shift towards a greener economic paradigm.

Materials and Methods

This research employs a mixed-methods approach. It includes a comprehensive review of existing literature on digital trade, green economy initiatives, and the intersection of technology and sustainability. Furthermore, the study incorporates an analysis of case studies illustrating successful applications of digital trade in promoting environmental sustainability across various sectors. Data sources include academic databases, industry reports, and policy documents from international

organizations and governments. The analytical framework focuses on identifying key pathways through which digital trade influences environmental outcomes, such as supply chain optimization, dematerialization of goods and services, and the facilitation of sustainable consumption.

This study is grounded in several key theoretical frameworks:

- **Digital Economy Theory:** This theory provides insights into how economic activities are transformed by digital technologies, emphasizing the role of data, information networks, and digital platforms in shaping production, consumption, and trade (Jabłoński & Jabłoński, 2020).
- **Green Economy Theory:** This framework focuses on achieving economic growth and development in an environmentally sustainable manner, emphasizing resource efficiency, pollution reduction, and the transition to cleaner technologies (Green economy, n. d.).
- **Technological Innovation Theory:** This theory explains how new technologies are developed, adopted, and diffused within an economy, highlighting the role of R&D, knowledge spillovers, and supportive ecosystems in driving progress (Gielen et al., 2019).
- **Industrial Transformation Theory:** This framework analyzes the structural changes within an economy, including the evolution of industries, shifts in production factors, and the impact of technological advancements on industrial organization (Carlsson, 2004).

Results and Discussion

Digital trade offers several pathways to support the green economy. Firstly, e-commerce platforms enable greater transparency and efficiency in supply chains, potentially reducing logistical inefficiencies and associated carbon emissions (OECD, 2023). Secondly, the digitalization of products and services (e.g., e-books, software downloads) contributes to dematerialization, decreasing the demand for physical resources and minimizing waste (European Environment Agency, 2024). Thirdly, digital marketplaces can facilitate the trade of environmentally friendly goods and services, connecting conscious consumers with sustainable producers (UNEP, 2022). Moreover, advanced technologies underpinning digital trade, such as AI and big data analytics, can enhance environmental monitoring and resource management (World Economic Forum, 2024). For instance, blockchain technology can improve traceability in sustainable supply chains, ensuring the authenticity and environmental credentials of products (IBM, 2023). However, challenges such as increased last-mile delivery emissions and the environmental impact of digital infrastructure need to be addressed through policy and technological innovation.

A theoretical model on the picture 1 is constructed to illustrate the hypothesized relationships among four core variables: the digital economy, industrial structure, technological innovation, and the green economy. The model posits that the digital economy directly and indirectly influences the green economy through two key mediating factors:

- **Industrial Structure:** The development of the digital economy drives the digitization of traditional industries and facilitates industrial upgrading, which in turn creates opportunities for the growth of the green economy.
- **Technological Innovation:** The digital economy enhances the efficiency of technological innovation through advancements in information technology and big data, leading to the development and adoption of green technologies that support the green economy.

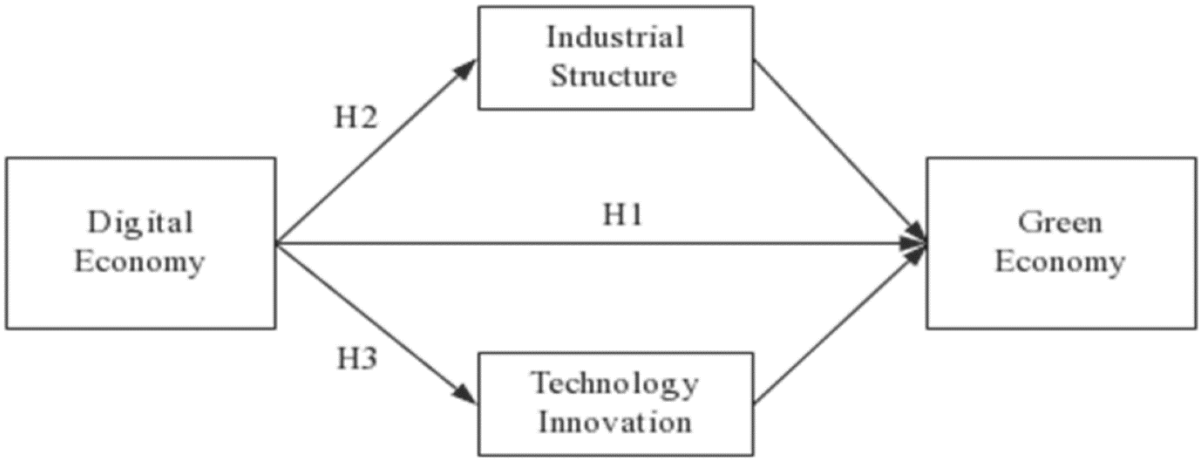

Figure 1. Theoretical model (Jabłoński & Jabłoński, 2020)

The theoretical analysis suggests a positive relationship between the digital economy and the green economy (Green economy, n. d.). The digital economy fosters technological innovation, leading to the development of green technologies and energy-efficient solutions (Jabłoński & Jabłoński, 2020). Moreover, it drives the transformation of resource-intensive economies towards more sustainable models. While some scholars argue about potential competition for resources, the overall impact of the digital economy in creating new business models and opportunities for green initiatives is expected to be positive. This align with the analyses outcome that hows a positive impact on the green economy.

The study posits that industrial structure acts as a crucial intermediary in the relationship between the digital economy and the green economy. The digitization of traditional industries, facilitated by the digital economy, leads to industrial upgrading and enhanced resource use efficiency. This structural transformation creates favorable conditions for the development and promotion of the green economy, particularly in addressing resource scarcity and environmental pollution. Thus, we expect the theoretical analysis to support the point that the digital economy shows a positive impact on the green economy through industrial structure.

Technological innovation, driven by advancements in information technology and big data within the digital economy, is expected to positively influence the green economy. The digital economy enhances the efficiency of technological innovation, leading to the development of environmental protection technologies and green products in sectors like energy and water resources. These technological advancements are crucial for the development of the green economy and the improvement of environmental protection capabilitie (Kwilinski, 2025). Consequently, we anticipate theoretical support for the statetment that the digital economy shows a positive impact on the green economy through technological innovation., suggesting a positive indirect impact of the digital economy on the green economy through technological innovation. Figure 2 shows the logarithmic trends of key innovation indicators across the Visegrad Group countries from 2007 to 2022.

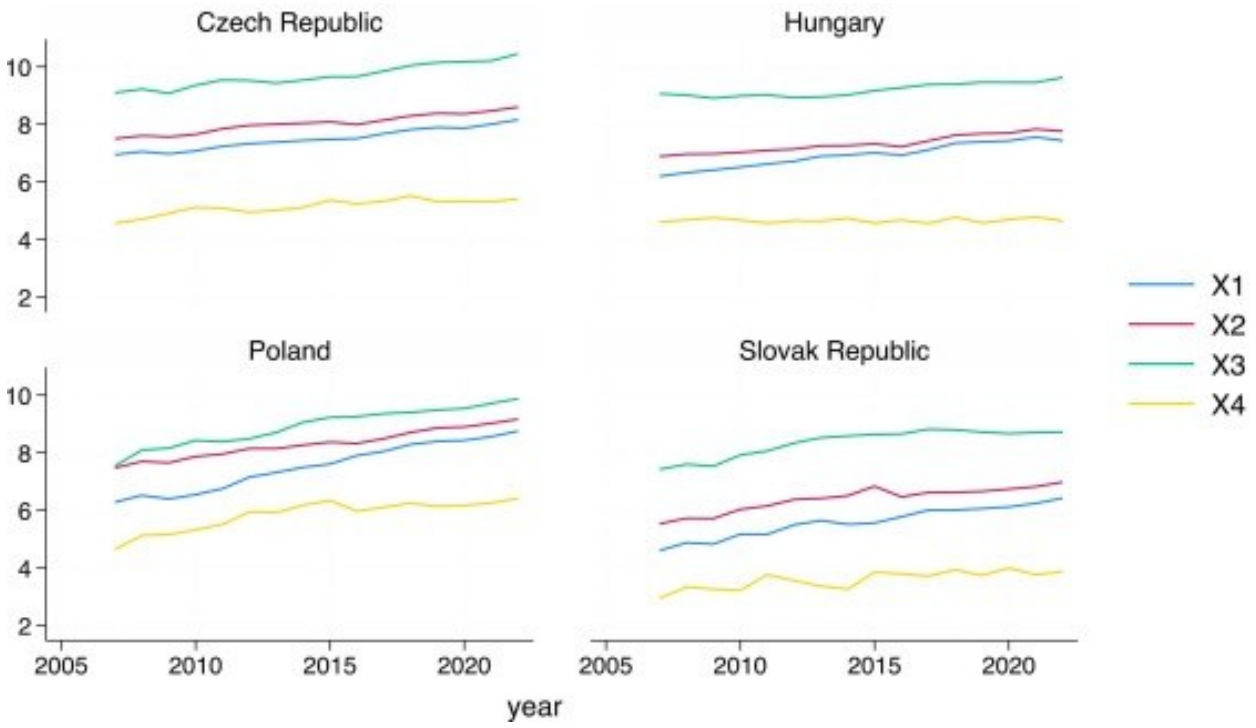

Figure 2. The trends of key innovation indicators across the Visegrad Group countries from 2007 to 2022 (Kwilinski, 2025)

Electronic commerce also has a significant impact on environmental aspects, such as the reduction of paper-based document flow. The use of electronic invoices, waybills, and confirmations allows for a decrease in paper consumption and reduces the burden on the environment. According to data from the European Commission, electronic payment systems enable savings of up to 6 million tons of paper annually (Khrapkina, 2024).

The application of environmentally friendly technologies in transportation is an important aspect of the sustainable development of electronic commerce. The use of electric trucks and biodegradable packaging materials helps to reduce the negative impact on the environment. IKEA and Amazon are examples of companies actively investing in sustainable transport and logistics solutions, including green warehouses and electric trucks. The use of technologies to track the most efficient delivery routes helps to reduce CO2 emissions. For example, DHL reported that by implementing logistics optimization algorithms, it managed to reduce CO2 emissions by 10% during 2021 (Khrapkina, 2024).

Conclusions

This theoretical study has explored the potential of digital trade as a catalyst for the transition towards a green economy, focusing on the direct impact of the digital economy and its indirect effects mediated by industrial structure upgrading and technological innovation. The proposed theoretical model and hypotheses suggest that the advancement of the digital economy can positively contribute to green economic development by fostering technological innovation in sustainable solutions and driving the transformation of industrial structures towards more environmentally friendly configurations.

The analysis indicates that the digital economy enables the development and adoption of green technologies, promotes resource efficiency, and facilitates the emergence of new, sustainable business models. Furthermore, the digitization of traditional industries, driven by the digital economy, leads to industrial upgrading, characterized by a reduced reliance on polluting sectors and an increased focus on green industries. Enhanced technological innovation, spurred by the digital economy's advancements in information and data technologies, plays a crucial role in developing and deploying environmental protection technologies.

Conflict of interest

The authors state no conflict of interest.

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