

Measuring the Impact of Payment Innovations in Sustainable Finance: A Refined Framework for Evaluating ESG, Social Equity, Financial Inclusion, and Efficiency

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ABSTRACT

The increasing focus on sustainable finance has led to a growing demand for tools to assess the environmental, social, and governance (ESG) impact of financial products and services. This article proposes a refined framework, the Payment Sustainability Index (PSI), to measure the sustainability performance of payment innovations. PSI integrates traditional ESG metrics with considerations of social equity, financial inclusion, and efficiency, weighted by their financial significance. This holistic approach allows for a comprehensive evaluation of payment innovations that balances sustainability with economic viability. The article discusses the theoretical foundations of the PSI, drawing on stakeholder theory, the triple bottom line, and impact investing principles. It also details the methodology for calculating the PSI, including the selection of metrics, weighting, and normalisation. The applicability of PSI is demonstrated through case studies of mobile money and blockchain-based supply chain finance. The article concludes by discussing the implications of PSI for financial institutions, policymakers, and consumers, highlighting its potential to drive innovation, inform regulation, and empower consumers to make more sustainable payment choices.

Keywords: sustainable finance, payment innovations, ESG, social equity, financial inclusion, efficiency, Payment Sustainability Index (PSI).

1. Introduction

The global financial landscape is rapidly evolving, driven by a growing emphasis on sustainable finance, an approach that integrates environmental, social, and governance (ESG) factors into investment and operational decisions. As investors, consumers, and regulators increasingly demand more responsible and impactful financial practices (United Nations Principles for Responsible Investment [PRI], 2023), financial institutions are under pressure to adopt sustainable strategies in all aspects of their operations, including payment systems.

Payment innovations, such as mobile wallets, digital currencies, and blockchain-based platforms, are reshaping how financial transactions are conducted. These technologies have the potential to improve financial inclusion (World Bank, 2023), reduce transaction costs, and improve efficiency. However, its impact on sustainability remains a multifaceted and underexplored issue, as highlighted by Lipis Advisors (2024).

Recent research suggests that the relationship between a firm's environmental, social, and governance (ESG) rating and its green innovation may not be linear, particularly highlighting the varying impacts on different types of green innovation (Yang et al., 2024).

Recognising the need for a comprehensive assessment tool, this article proposes a refined framework for measuring the impact of payment innovations on sustainable finance. This framework not only considers traditional ESG metrics but also introduces a quantitative approach, the Payment Sustainability Index (PSI),

which incorporates the financial significance of each factor. In addition, the framework expands its scope to include social equity and financial inclusion, aligning with the larger goals of sustainable development. By doing so, it provides a holistic evaluation that balances sustainability, social impact, and economic viability, aligning with the insights from Lipis Advisors (2024) regarding the importance of a comprehensive approach.

2. Theoretical Analysis

Sustainable Finance and ESG Frameworks. Sustainable finance has emerged as a critical response to the growing urgency to address environmental and social challenges. A large body of literature examines various aspects of sustainable finance (Kayani et al., 2024; Birindelli et al., 2023; Fatica & Panzica, 2024; Lange & Banadaki, 2024; Tanjung, 2023; Meira et al., 2023) including its theoretical foundations, investment strategies, and impact measurement approaches. Research on ESG frameworks, such as the UN Principles for Responsible Investment (PRI) and the Sustainability Accounting Standards Board (SASB) standards (SASB, 2023), provides valuable insights into defining and measuring ESG factors in financial decision making. The Task Force on Climate-related Financial Disclosures (TCFD) is another important framework that has gained prominence in recent years, providing recommendations for disclosing climate-related financial risks (Task Force on Climate-related Financial Disclosures, 2017). Furthermore, studies such as Hanegraaf et al. (2018) and Lindgreen et al. (2018) have specifically investigated the life cycle assessment of cash and debit card payments, respectively, providing valuable insights into their environmental footprints.

Payment Innovations and Sustainability. The literature on payment innovations has largely focused on their technological aspects, adoption rates, and economic implications (Schueffel, 2017; Ng et al., 2024; Boakye-Adjei et al., 2023; Alshehadeh & Al-Khawaja, 2022). However, there is a growing body of research exploring the potential of payment innovations to contribute to the goals of sustainable development. Studies have examined the role of mobile money in financial inclusion (World Bank, 2023), the potential of blockchain to improve supply chain transparency (World Economic Forum, 2018), and the use of digital currencies to offset carbon. As Lipis Advisors (2024) noted, a comparative analysis of payment instruments' ESG impact is crucial in understanding their sustainability performance.

Social Equity and Financial Inclusion in Payment Innovations. In addition to the environmental and governance aspects of sustainability, the social dimension is increasingly recognised as a critical component of sustainable finance (Kuznyetsova et al., 2022). This includes considerations of social equity and financial inclusion, particularly in the context of payment innovations. Research has shown that payment innovations can have a significant impact on social equity by providing access to financial services for marginalised populations (World Bank, 2023). For example, mobile money has been instrumental in expanding financial inclusion in many developing countries, enabling individuals and businesses to participate more fully in the economy (GSMA, 2023).

Gaps in the Literature and Theoretical Frameworks. Despite growing interest in the social impact of payment innovations, there remains a gap in research that systematically quantifies this impact alongside ESG and financial considerations. Most existing studies focus on qualitative assessments or specific use cases, lacking a comprehensive and quantifiable framework. Furthermore, the assumption of a linear relationship between corporate ESG performance and outcomes such as green innovation has been challenged by recent research, which suggests a U-shaped relationship instead (Yang et al., 2024). This highlights the need for a framework that can capture the nuances and complexities of this relationship, particularly the varying impacts on different types of green innovation (inventive vs. non-inventive).

This research draws on several theoretical frameworks to bridge this gap. Stakeholder theory (Freeman, 1984) emphasises considering the interests of all parties affected by a payment innovation, including consumers, merchants, financial institutions, regulators, and the environment. The triple bottom line

(Elkington, 1997) provides a framework for evaluating economic, social and environmental impacts, while impact investing (Bugg-Levine & Emerson, 2011) focusses on investments generating positive social and environmental impacts alongside financial returns.

The findings of Yang et al. (2024) raise important questions about how the U-shaped relationship between ESG ratings and green innovation affects the balance between these three pillars of the triple bottom line. For instance, does the initial focus on governance by "bad" companies (with low ESG ratings) create a trade-off between short-term economic performance and long-term environmental sustainability? How does the subsequent increase in green innovation by "good" companies (with high ESG ratings) contribute to a more balanced and integrated approach to sustainable development?

By integrating these perspectives, this study seeks to develop a holistic and practical assessment model that encompasses ESG, social equity, financial inclusion, and efficiency.

3. Methodology for the Calculation of The Payment Sustainability Index (PSI)

To address the identified gaps and provide a practical tool for financial institutions, we propose the Payment Sustainability Index (PSI). The PSI is a quantitative measure that evaluates the impact of payment innovations in the dimensions of ESG, social equity, financial inclusion, and efficiency, considering the financial significance of each factor. It also aligns with the recommendations of the TCFD framework by incorporating climate-related financial risks into the assessment.

Assessment process. The assessment process using PSI involves the following steps:

1. *Data Collection:* Gather relevant data for each metric from internal records, external reports, surveys, or interviews. These data should be as comprehensive and up to date as possible, drawing on both quantitative and qualitative sources as needed (Lipis Advisors, 2024).
2. *Normalisation:* Normalise the data for each metric to a scale of 0-1, where 0 represents the worst performance and 1 represents the best. This ensures that all metrics are comparable, regardless of their original units of measurement.
3. *Weighted Calculation:* Multiply the normalised score for each metric by its corresponding weight and sum the results. This step reflects the relative importance of each metric in the overall assessment.
4. *PSI Calculation:* Divide the weighted sum by the total sum of the weights to obtain the PSI value. This final value represents the overall sustainability and financial performance of the payment innovation, including its consideration of climate-related financial risks.

To calculate PSI we propose to use following formula:

$$PSI = \frac{\sum w_i \times x_i}{\sum w_i} \quad (1)$$

Where:

w_i : Weight assigned to each metric (i) based on its financial significance.

x_i : Performance score of the innovation of the payment on each metric (i) on a scale of 0 to 1.

Metrics and weights. The PSI incorporates a range of metrics that reflect the multifaceted nature of sustainability in the context of payment innovations (Table 1). These metrics are categorised into four broad dimensions: environmental, social, governance (ESG), and efficiency. Each metric is assigned a weight based on its perceived financial importance, reflecting the potential impact on the financial performance and long-term viability of the payment innovation.

Table 1: Proposed metrics for the PSI

Metrics	Reference	Justification
Transaction Cost	European Central Bank (ECB). (2023). Payments statistics (full report).	Directly impacts the revenue and profitability of payment providers and merchants.
Transaction speed	European Central Bank (ECB). (2023). Payments statistics (full report).	Affects customer satisfaction, operational efficiency, and cash flow.
Accessibility	World Bank. (2023). The Global Findex Database 2021	Broader accessibility can lead to increased transaction volumes and revenue.
Scalability	Lipis Advisors. (2024). A comparative analysis of the ESG impact of payment instruments.	The ability to handle growth is crucial for long-term financial viability.
Carbon Footprint	European Central Bank (ECB). (2023). Product Environmental Footprint Study of Euro Banknotes	Increasingly relevant for regulatory compliance and consumer preferences.
Energy Consumption	International Monetary Fund (IMF). (2022). Digital currencies and energy consumption.	Indirectly affects operational costs and brand reputation.
Resource Use	European Central Bank (ECB). (2023). Product Environmental Footprint Study of Euro Banknotes	Relevant for long-term sustainability and resource scarcity concerns.
Financial inclusion	World Bank. (2023). The Global Findex Database 2021	Expanding access to financial services can open new markets and revenue streams.
Data Privacy and Security	Mayer Brown. (2022). FSB finalises recommendations on approaches to climate-related risks.	Crucial for risk management and maintaining customer trust.
Community Impact	GSMA. (2023, 2024). State of the Industry Report on Mobile Money 2023&2024.	Can enhance the brand reputation and social licence to operate.
Transparency	Lipis Advisors. (2024). A comparative analysis of the ESG impact of payment instruments.	Increasingly important for stakeholder trust and regulatory compliance.
Ethics and Compliance	United Nations Principles for Responsible Investment (PRI). (2023). About the PRI.	Essential for risk mitigation and long-term sustainability.
Stakeholder Engagement	United Nations Principles for Responsible Investment (PRI). (2023). About the PRI.	Can lead to better decision making and risk mitigation.

Metrics	Reference	Justification
Climate-Related Financial Risks	Mayer Brown. (2022). FSB finalises recommendations on approaches to climate-related risks.	It aligns with the recommendations of the TCFD and reflects the growing importance of climate risk management in sustainable finance.
Social Equity	World Bank. (2023). The Global Findex Database 2021	Ensures fairness and justice in access and distribution of financial services.

Weighting Methodology. The weighting methodology used in the PSI is based on a combination of expert judgment, literature review, and stakeholder consultation. Expert judgment involves obtaining input from industry experts, academics, and practitioners with experience in sustainable finance and payment systems. The review of the literature involves analysing existing research and reports to identify the most relevant and impactful metrics for assessing the sustainability of payment innovations. Stakeholder consultation involves engaging with various stakeholders, such as financial institutions, regulators, and consumer groups, to gather their perspectives on the relative importance of different sustainability factors.

The proposed weights for each metric are as shown in Table 2.

Table 2: Proposed weights for PSI metrics

Metrics	Dimension	Financial Significance	Proposed Weight	Justification
Transaction Cost	Efficiency	High	0.13	Directly impacts the revenue and profitability of payment providers and merchants.
Transaction speed	Efficiency	Medium	0.06	Affects customer satisfaction, operational efficiency, and cash flow.
Accessibility	Social	Medium	0.06	Broader accessibility can lead to increased transaction volumes and revenue.
Scalability	Efficiency	Medium	0.06	The ability to handle growth is crucial for long-term financial viability.
Carbon Footprint	Environmental	Low	0.06	Increasingly relevant for regulatory compliance and consumer preferences.
Energy Consumption	Environmental	Low	0.03	Indirectly affects operational costs and brand reputation.
Resource Use	Environmental	Low	0.03	Relevant for long-term sustainability and resource scarcity concerns.

Metrics	Dimension	Financial Significance	Proposed Weight	Justification
Financial inclusion	Social	Medium	0.08	Expanding access to financial services can open new markets and revenue streams.
Data Privacy and Security	Governance	High	0.10	Crucial for risk management and maintaining customer trust.
Community Impact	Social	Low	0.03	Can enhance the brand reputation and social licence to operate.
Transparency	Governance	Medium	0.06	Increasingly important for stakeholder trust and regulatory compliance.
Ethics and Compliance	Governance	High	0.10	Essential for risk mitigation and long-term sustainability.
Stakeholder Engagement	Governance	Low	0.03	Can lead to better decision making and risk mitigation.
Climate-Related Financial Risks	Environmental	Medium	0.08	It aligns with the recommendations of the TCFD and reflects the growing importance of climate risk management in sustainable finance.
Social Equity	Social	Medium	0.08	Ensures fairness and justice in access and distribution of financial services.

It is important to note that these weights are not fixed and can be adjusted based on the specific context and priorities of the assessment. For example, a financial institution that places a high value on financial inclusion can choose to assign a higher weight to that metric. Similarly, a regulator focused on climate change mitigation can prioritise the carbon footprint and energy consumption metrics.

Sensitivity analysis. To assess the robustness of the PSI and the impact of different weighting scenarios, sensitivity analyses can be performed. These analyses involve systematically varying the weights assigned to each metric and observing the resulting changes in the overall PSI score. This can help identify the most influential metrics and provide insights into the potential trade-offs between different sustainability objectives. For example, increasing the weight of the carbon footprint metric would likely result in a lower PSI score for payment innovations with high carbon emissions, highlighting the importance of this factor in the overall sustainability assessment.

Interpretation. The PSI value provides a quantitative measure of the overall sustainability and financial performance of payment innovation, including consideration of climate-related financial risks. A higher PSI indicates a more sustainable and financially viable solution. Financial institutions can use PSI to compare different payment innovations, prioritise investments, and track their progress over time.

4. Applications of PSI

The PSI framework has broad applicability beyond individual payment assessments. It can be used for:

- *Comparative analysis: compare* different payment technologies (e.g., mobile wallets vs. blockchain) or competing products within a technology. For example, the study by Lipis Advisors (2024) shows that batch payments have a lower environmental impact than instant payments due to the way they are processed. This could be reflected in the PSI by assigning a higher weight to the energy consumption metric for instant payments compared to batch payments.
- *Portfolio Analysis: assess* the sustainability and financial performance of an institution's entire payment portfolio, tracking progress over time. PSI can help financial institutions identify which payment methods in their portfolio are the most (or least) sustainable, allowing them to make informed decisions about which methods to promote or phase out.
- *Benchmarking and reporting: benchmarking* the sustainability performance of different financial institutions, facilitating transparent ESG reporting. As the Lipis Advisors (2024) study points out, there is a lack of standardised ESG reporting in the payments industry. The PSI could serve as a standardised metric that financial institutions can use to report their sustainability performance in a comparable way.
- *Regulatory and policy applications: informing* the development of regulations and assessing the effectiveness of policies promoting sustainable payment practices. For example, policymakers could use the PSI to set energy consumption thresholds for different payment methods or to incentivise the use of more sustainable payment technologies.
- *Consumer awareness and choice: educate* consumers about the sustainability implications of payment choices, potentially leading to labelling and certification schemes for sustainable payment products. By understanding the environmental impact of different payment methods, consumers can make more informed choices about how they pay for goods and services.

Case Studies. To illustrate the application of the PSI, we present two case studies enhanced with data and insights from the GSMA (2023, 2024) and WEF (2018) reports.

Mobile Money in Emerging Markets. Mobile money has emerged as a transformative payment innovation in emerging markets, providing financial services to unbanked and underbanked populations. The PSI can be used to assess the sustainability impact of mobile money, considering factors such as financial inclusion, transaction costs, energy consumption, and data privacy. For example, the GSMA reports (2023, 2024) highlight the positive impact of mobile money on financial inclusion, particularly in Sub-Saharan Africa. In 2021, 33% of adults in this region had a mobile money account, and mobile money adoption led to a 3.7% increase in GDP between 2013 and 2022. This demonstrates a significant contribution to the financial inclusion metric in the PSI. Moreover, the global average cost of sending \$200 via mobile money was 3.73% in 2023, significantly lower than other methods, indicating a high score for the transaction cost metric. However, energy consumption associated with mobile money infrastructure and the increasing use of mobile devices, as highlighted in the GSMA reports, may be a concern, potentially lowering the PSI score for the energy consumption metric. Additionally, the environmental impact of mobile phone manufacturing and disposal (Hanegraaf et al., 2018) should be considered in a comprehensive PSI assessment.

Blockchain-Based Supply Chain Finance Blockchain technology has the potential to revolutionise supply chain finance by enhancing transparency, traceability, and efficiency. The PSI can be used to evaluate the sustainability impact of blockchain-based supply chain finance solutions, considering factors such as transaction speed, data security, resource use, and carbon footprint. For example, the report of the World Economic Forum (2018) emphasises the potential of blockchain to reduce fraud and improve transparency in supply chains, which would contribute to a higher PSI score in terms of transaction speed and data privacy and security. The increasing use of mobile money for merchant payments, as highlighted in the

GSMA report (2024), further demonstrates the growing acceptance of digital transactions and blockchain-based solutions. However, the energy-intensive nature of blockchain technology, particularly with proof-of-work (PoW) consensus mechanisms, may be a drawback, potentially lowering the PSI score for the resource use and carbon footprint metrics. The assessment could also consider the environmental impact of the hardware used in blockchain mining and transaction validation (Lindgreen et al., 2018) and explore the potential of more energy-efficient alternatives like proof-of-stake (PoS) consensus mechanisms.

While the environmental impact of mobile money and blockchain-based solutions is still an emerging area of research, studies on cash and debit card payments (Hanegraaf et al., 2018; Lindgreen et al., 2018) underscore the importance of considering the full life cycle of payment innovations when assessing their sustainability.

By applying the proposed framework to these case and other studies, we can gain valuable insights into the diverse impacts of payment innovations in sustainable finance. These insights can inform decision making for financial institutions, policymakers, and other stakeholders seeking to promote more sustainable and inclusive financial systems.

5. Discussion

The proposed framework for measuring the impact of payment innovations in sustainable finance offers several key implications for various stakeholders. For financial institutions, this framework can serve as a valuable tool for guiding decision-making around the adoption and promotion of payment solutions. By systematically assessing the impacts of ESG, social equity, financial inclusion, and efficiency of different innovations, institutions can identify those that align best with their sustainability goals and contribute to broader social goals.

For policymakers, this framework can inform the development of regulations and incentives that promote sustainable and equitable payment practices. By understanding the various impacts of payment innovations, policymakers can create an enabling environment for those that contribute to positive ESG and social outcomes, while discouraging those with negative externalities or those that exacerbate existing inequalities. Moreover, the framework can serve as a basis for standardised reporting requirements, enhancing transparency and comparability between different financial institutions.

However, implementing this framework also presents several challenges. First, data collection and measurement can be complex and resource intensive, especially for smaller institutions or those operating in data-scarce environments. Second, there may be a lack of standardised metrics and benchmarks for assessing social equity and financial inclusion in the context of payment innovations, making comparisons and evaluations challenging. Third, the rapid pace of technological change in the payment industry may require frequent updates and adjustments to the framework to remain relevant and capture emerging trends and risks. The findings of Yang et al. (2024) further underscore the dynamic nature of ESG ratings and green innovation, suggesting that the PSI may need to be adapted to account for the evolving relationship between these factors. For example, the weights assigned to different metrics within the PSI could be adjusted based on the current ESG rating of the financial institution or the specific type of green innovation being evaluated.

Despite these challenges, the potential benefits of this framework are significant. By integrating ESG, social equity, and financial inclusion considerations into the evaluation of payment innovations, financial institutions can play a more proactive role in driving sustainable and inclusive development. Furthermore, by prioritising efficiency, institutions can ensure that their payment solutions are not only sustainable and equitable but also cost effective and accessible to a wide range of users, including marginalised populations.

In addition to the immediate benefits for financial institutions and policymakers, this framework has broader implications for the sustainable finance ecosystem. It can stimulate innovation by encouraging the development of payment solutions that explicitly address ESG, social equity, and financial inclusion concerns. It can also raise awareness among consumers and investors about the importance of sustainable and equitable payment practices, leading to increased demand for responsible financial products and services.

Future research could explore the correlation between PSI scores and long-term financial performance, providing further evidence of the value of sustainable payment practices. Additionally, the research could investigate how the PSI influences consumer behaviour and preferences for sustainable payment options, potentially leading to the development of more effective strategies for promoting sustainable finance.

Overall, the proposed framework offers a starting point for a more comprehensive and systematic approach to evaluating the impact of payment innovations in sustainable finance. Although there are challenges to overcome, the potential rewards for financial institutions, policymakers, and society as a whole are substantial.

6. Conclusions

In conclusion, this article has proposed the Payment Sustainability Index (PSI) as a comprehensive framework to measure the impact of payment innovations on sustainable finance. By integrating ESG, social equity, financial inclusion and efficiency metrics, weighted by their financial significance, the PSI offers a quantitative tool to assess the holistic value of payment solutions. Through case studies of mobile money and blockchain-based supply chain finance, we have demonstrated the applicability of PSI and its potential to guide decision making for financial institutions.

This research underscores the importance of a nuanced understanding of the impact of payment innovations. While functionality and efficiency are essential considerations, it is equally crucial to assess their environmental, social, governance, and broader societal consequences. By applying the PSI framework, financial institutions can identify and promote payment solutions that not only drive financial performance but also contribute to a more sustainable and inclusive future.

The PSI is not a static tool but rather a starting point for ongoing research and refinement. Future studies can explore additional metrics, refine the weighting methodology, and incorporate dynamic adjustments to reflect the evolving landscape of sustainable finance and payment technologies. Furthermore, collaboration between financial institutions, policymakers, and researchers is essential to ensure widespread adoption and continuous improvement of the PSI.

The journey towards a truly sustainable financial system is a complex and ongoing one. However, by embracing innovation, measuring impact through comprehensive frameworks like PSI, and prioritising ESG, social equity, and financial inclusion considerations, we can pave the way for a more responsible and impactful financial industry.

References

Alshehadeh, A. R., & Al-Khawaja, H. A. (2022). Financial Technology as a Basis for Financial Inclusion and its Impact on Profitability: Evidence from Commercial Banks. *International Journal of Advances in Soft Computing and Its Applications*, 14(2), 125–138. <https://doi.org/10.15849/IJASCA.220720.09>

- Boakye-Adjei, N. Y., Auer, R., Banka, H., Faragallah, A., Frost, J., Natarajan, H., & Prenio, J. (2023). Can central bank digital currencies help advance financial inclusion? *Journal of Payments Strategy and Systems*, 17(4), 433–447.
- Bugg-Levine, A., & Emerson, J. (2011). *Impact investing: Transforming how we make money while making a difference*. Jossey-Bass.
- Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. New Society Publishers.
- European Central Bank (ECB). (2023). Product Environmental Footprint Study of Euro Banknotes as a Payment Instrument. <https://www.ecb.europa.eu/pub/pdf/other/ecb.pefreport202312~81e945e7aa.en.pdf>
- European Central Bank (ECB). (2023). Payments statistics (full report). <https://data.ecb.europa.eu/sites/default/files/2023-09/Payment%20Statistics%20%28full%20report%29.pdf>
- Fatica, S., & Panzica, R. (2024). Sustainable investing in times of crisis: Evidence from bond holdings and the COVID-19 pandemic. *Journal of Banking and Finance*, 166. <https://doi.org/10.1016/j.jbankfin.2024.107238>
- Freeman, R. E. (1984). *Strategic Management: A stakeholder approach*. Cambridge University Press.
- French Banking Federation, Ernst and Young, Bio Intelligence Service. (2011). Environmental footprint of payment methods.
- GSMA. (2023). *State of the Industry Report on Mobile Money 2023*. <https://www.gsma.com/mobilefordevelopment/resources/state-of-the-industry-report-on-mobile-money-2023/>
- GSMA. (2024). *State of the Industry Report on Mobile Money 2024*. <https://www.gsma.com/sotir/>
- Hanegraaf, R., Jonker, N., Mandley, S., & Miedema, J. (2018). Life cycle assessment of cash payments. De Nederlandsche Bank.
- International Monetary Fund (IMF). (2022). Digital currencies and energy consumption. *Fintech Notes*. <https://www.imf.org/en/Publications/fintech-notes/Issues/2022/06/07/Digital-Currencies-and-Energy-Consumption-517866>
- Kayani, U. N., Gan, C., Rabbani, M. R., Trichilli, Y. (2024). Is short-term firm performance an indicator of a sustainable financial performance? Empirical evidence. *Studies in Economics and Finance*, 41(3): 619-637.
- Kuznyetsova, A., Boiarko, I., Khutorna, M., & Zhezherun, Y. (2022). Development of financial inclusion from the standpoint of ensuring financial stability. *Public and Municipal Finance*, 11(1), 20–36. [https://doi.org/10.21511/pmf.11\(1\).2022.03](https://doi.org/10.21511/pmf.11(1).2022.03)
- Lange, E. M., & Banadaki, N. G. (2024). ESG consideration in venture capital: drivers, strategies and barriers. *Studies in Economics and Finance*, 41(3), 724–739. <https://doi.org/10.1108/SEF-06-2023-0380>
- Lindgreen, E. R., van Schendel, M., Jonker, N., Kloek, J., de Graaff, L., & Davidson, M. (2018). Evaluating the environmental impact of debit card payments. *The International Journal of Life Cycle Assessment*, 23(11), 1847-1861.
- Lipis Advisors. (2024). *A comparative analysis of the ESG impact of payment instruments*. https://eacha.org/form_download.php?doc=ESG%20impact%20of%20payment%20instruments%20-%20EACHA%20whitepaper%20-%20May%202024

- Mayer Brown. (2022). FSB finalises recommendations on approaches to climate-related risks. <https://www.mayerbrown.com/en/perspectives-events/publications/2022/10/fsb-finalizes-recommendations-on-approaches-to-climate-related-risks>
- Meira, E., Cunha, F. A. F. D. S., Orsato, R. J., Miralles-Quirós, M. M., & Miralles-Quirós, J. L. (2023). The added value and differentiation among ESG investment strategies in stock markets. *Business Strategy and the Environment*, 32(4), 1816–1834. <https://doi.org/10.1002/bse.3221>
- Ng, W.-K., Chen, S., Chen, W.-H., Chen, C.-L., & Jiang, J.-L. (2024). Mobile Payment Innovation Ecosystem and Mechanism: A Case Study of Taiwan's Servicescapes. *Journal of Theoretical and Applied Electronic Commerce Research*, 19(1), 633–653. <https://doi.org/10.3390/jtaer19010034>
- Schueffel, P. (2017). Taming the Beast: A scientific definition of fintech. *Journal of Innovation Management*, 5(4), 32-54.
- Sustainability Accounting Standards Board (SASB). (2023). *SASB standards*. <https://sasb.org/standards/>
- Tanjung, M. (2023). Cost of capital and firm performance of ESG companies: what can we infer from COVID-19 pandemic? *Sustainability Accounting, Management and Policy Journal*, 14(6), 1242–1267. <https://doi.org/10.1108/SAMPJ-07-2022-0396>
- Task Force on Climate-Related Financial Disclosures (TCFD). (2017). Recommendations of the Climate-Related Financial Disclosure Task Force. <https://www.fsb-tcfd.org/publications/final-recommendations-report/>
- United Nations Principles for Responsible Investment (PRI). (2023). *About the PRI*. <https://www.unpri.org/about-us/what-are-the-principles-for-responsible-investment>
- World Bank. (2023). *The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19*. <https://www.worldbank.org/en/publication/globalfindex>
- World Economic Forum. (2018). *Building Block(chain)s for a Better Planet*. https://www3.weforum.org/docs/WEF_Building-Blockchains.pdf
- Yang, C., Zhu, C., & Albitar, K. (2024). *ESG ratings and green innovation: A U-shaped journey towards sustainable development*. *Business Strategy and the Environment*, 1–22. <https://doi.org/10.1002/bse.3692>