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Greening the recovery: Efficiency in natural resource markets

Abdulrasheed Zakari [a,*], Vincent Konadu Tawiah [b], Stefania Pinzon [c]

[a] Business and Law, University of Wollongong, Australia
[b] DCU Business School, Dublin City University, Ireland
[c] Esai Business School, Universidad Espiritu Santo, Samborondon, 091650, Ecuador

A R T I C L E I N F O

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A B S T R A C T

The present study investigates the correlation between resource trading and green economic recovery strategies, with a particular focus on the scientific contribution towards understanding the effects of trade on environmental sustainability in 43 African countries from 1973 to 2019. The results demonstrate that although the exportation of natural resources can impede the achievement of environmentally friendly economic goals, the importation of resources can stimulate the development of sustainable technology through trade. Resource trading plays a crucial dual function for policymakers seeking to achieve a harmonious equilibrium between economic development and sustainability. The significance of this study is in the provision of practical suggestions, such as the adaptation of resource portfolios, the incorporation of environmental provisions into trade agreements, the allocation of resources towards sustainable infrastructure, and the advancement of inclusive development. These solutions provide a practical method for harmonizing resource trade policies with the goals of green economic recovery. This work enhances the existing literature on sustainable development by examining the trade-offs and synergies between resource trade and sustainability. It provides practical strategies for attaining a balanced and environmentally ecologically sound economic recovery.

1. Introduction

In the wake of unprecedented global challenges such as climate change, biodiversity loss, and the ongoing COVID-19 pandemic, the imperative to transition towards a sustainable and environmentally resilient future has never been more pressing. As nations and industries grapple with the urgency of addressing these issues, the concept of a "green recovery" has emerged as a pivotal strategy to simultaneously stimulate economic growth and combat environmental degradation (Better, 2022). This study delves into a critical dimension of this green recovery—the role of efficiency in the natural resource trade.

Natural resources, encompassing everything from minerals and fossil fuels to agricultural products and renewable energy sources, lie at the heart of economic development and industrialization. However, the extraction, production, and trade of these resources have historically been associated with environmental degradation, resource depletion, and socioeconomic inequalities (Gu et al., 2023; Sekhri, 2022; Zakari et al., 2022). In this context, the quest for a green recovery demands a fundamental revaluation of how we utilize and exchange natural resources.

Efficiency emerges as a central theme in this discourse. The efficient use of natural resources holds the potential to not only reduce environmental impacts but also enhance economic productivity, bolstering the prospects of a green recovery (Hsu et al., 2023; Zhang and Dilanchiev, 2022). However, the complexities surrounding resource efficiency extend far beyond mere conservation and encompass a myriad of interconnected factors, including technological innovation, regulatory frameworks, market dynamics, and global supply chains (Hao et al., 2022; Isayev et al., 2022).

This study seeks to unpack the relationship between efficiency and natural resource trade, shedding light on its potential as a catalyst for a sustainable and resilient future. As anticipated, a negative correlation exists between the trade and export of resources and the attainment of a green economic recovery. This suggest that there is a correlation between the trading and exporting of resources and a decline in the progress of environmentally sustainable economic recovery. Our findings indicate a negative correlation between resource exports and the potential for a green economic recovery. This process is made possible with technological advancements.

This study significantly advances the understanding of how resource

* Corresponding author.
E-mail addresses: el_rasheed81@yahoo.com, azakari@uow.edu.au (A. Zakari), vincent.tawiah@dcu.ie (V.K. Tawiah), yajairapinzon61@gmail.com (S. Pinzon).

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trading impacts green economic recovery, particularly through its dual effects on sustainability. The novelty of this study lies in its nuanced examination of both resource trade's positive and negative roles in achieving environmental goals. Unlike previous studies, which often focus on single aspects of trade or environmental policy, this study highlights the contradictory nature of resource exportation as an obstacle and resource importation as a facilitator of green technology adoption. Furthermore, the study contributes new insights by providing specific, actionable recommendations for policymakers. These include strategies for resource portfolio diversification, integrating environmental clauses into trade agreements, and investments in sustainable infrastructure. Additionally, the study emphasizes the importance of inclusive development, ensuring that economic recovery efforts are equitable and environmentally sound. These contributions fill gaps in existing literature and offer practical solutions for aligning trade policies with sustainable development goals.

The subsequent sections of this study are as follows: Section two comprises a comprise of literature review, section three presents the data and methods employed, section four presents the results and subsequent discussion, and the final section encompasses the conclusion and policy implications.

2. Literature review

The relationship between efficient natural resource trade and sustainable development has been the subject of extensive research and scholarly discourse. Efficient natural resource management is a fundamental pillar of sustainable development. Studies such as those by Awosusi et al. (2022) and Usman and Balsalobre-Lorente (2022) emphasize the importance of resource efficiency in reducing environmental impacts and conserving vital resources. These studies highlight the potential for increased resource productivity to decouple economic growth from resource consumption, a central tenet of green recovery strategies.

Technological advancements play a pivotal role in enhancing resource efficiency. Studies by Ahakwa et al. (2023); Khan et al. (2022), and Yu et al. (2022) underscore the significance of innovation in reducing greenhouse gas emissions associated with resource extraction and processing. Moreover, the adoption of digital technologies and data-driven decision-making processes. According to Hassoun et al. (2022), the potential to optimize supply chains and resource use further promotes green recovery objectives. Effective policies and regulatory frameworks are essential in steering resource trade towards sustainability. Studies like Wang and Wang (2022) and Xu (2000) investigate the impact of environmental regulations and international agreements on resource efficiency and trade patterns. These studies illuminate the need for coordinated, cross-border efforts to align trade practices with green recovery goals.

The global nature of resource trade necessitates a nuanced understanding of supply chains and trade dynamics. Dimitratos and Jones (2010) explores the role of globalization in resource efficiency, highlighting both the opportunities for resource optimization through international trade and the risks of resource dependence. The COVID-19 pandemic has also brought to light the vulnerabilities in global supply chains and their implications for resource security and efficiency. Resource trade and efficiency are not purely technical matters; they are deeply intertwined with social, economic, and ethical considerations. For instance, Torugsa et al. (2013) examine the role of stakeholders, including local communities, indigenous groups, and civil society organizations, in shaping resource trade practices and ensuring that efficiency measures do not exacerbate social inequalities or environmental injustices.

Efforts to enhance efficiency in resource trade often involve trade-offs and synergies with other sustainability objectives. For example, Taranic et al. (2016) explores the potential synergies between resource efficiency and circular economy principles, while studies (Khan et al., 2022; Livingstone et al., 2022; Ponce et al., 2023) investigate the trade-offs between resource efficiency and economic growth. These trade-offs and synergies are critical considerations for policymakers and businesses alike.

In summary, the literature review highlights the relationship between the efficiency of natural resource trade in the context of green recovery. We have identified technological, regulatory, social, and economic factors and the need for a holistic approach to address the challenges and opportunities posed by the quest for a sustainable and resilient future. Building upon these insights, the subsequent sections of this study will delve into empirical evidence and policy recommendations, aiming to contribute to the ongoing discourse on achieving a green recovery through efficient natural resource trade.

3. Data, theoretical models, and methodology

3.1. Data

In this section, we described the data in this study, which includes green economic recovery resource commodity exchange, import, and export data, as well as capital and labor. The study covers the period from 1973 to 2019 for 43 African countries.[1] Except for capital and labor, these data come from the World Bank's World Development Index database and the environmental live/global material flows database. The selection of these datasets is based on relevance factors, which include the research question and data coverage. Table 1 describes the data measurements.

3.2. Theoretical models and methodology

This study examines the relationships between natural resource trade and green economic recovery through the lens of green export-led development. Green export-led development is predicated on the notion that promoting environmentally sustainable products and services via exports can simultaneously drive economic growth and address environmental concerns. This can outline, in a simplified conceptual framework, the link between green exports and economic growth.

Assuming the economy produces environmentally sustainable goods (natural resources augmented by technological innovation). Where Y_g represent environmentally sustainable goods and X_g refer to the exports of environmentally sustainable goods. The Green ELG theory suggests that an increase in green exports can drive economic growth while promoting environmental sustainability. Therefore, the benchmark model is given as:

$$GER_{it} = \beta_0 + \beta_1 RCE_{it} + \beta_2 X_{it} + \varepsilon_{it} \tag{1}$$

Where *GER* represent the green economic recovery, *RCE* refer to the resource commodities exchange and X is the vector of control variables, which include capital and labor, and the i and t is country and time, while ε refer to the error terms.

The relationship between resource trade and green economic recovery is augmented with innovation to capture the moderating impact of technological advancement influence on natural resources and the impact on green economic recovery. Engaging in resource trade may expose the country to advanced technologies and managerial practices from trading partners. This technology transfer can improve efficiency and productivity across various sectors (Enzmann and Moesli, 2022).

[1] Algeria, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Cote d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, and Zimbabwe.

Table 1
Variable description and sources.

Variable	Descriptions	Sources
Green economic recovery (GER)	Adjusted net savings, including particulate emission damage (% of GNI)	WDI (2023)
Resources trade (RCE)	The amount of biomass, excavated earthen materials (including soil), fossil fuels, metal ores, mixed and complex products, non-metallic minerals, products from biomass, products from fossil fuels, products from metals, products from non-metallic minerals, and waste for final treatment and disposal exchanged with countries across the world (Tonnes).	Environment Live/Global Material Flows Database (2023)
Resources export (RCEP)	The amount of biomass, excavated earthen materials (including soil), fossil fuels, metal ores, mixed and complex products, non-metallic minerals, products from biomass, products from fossil fuels, products from metals, products from non-metallic minerals, and waste for final treatment and disposal exported to the rest of the world (Tonnes).	Environment Live/Global Material Flows Database (2023)
Resources import (RCIP)	The amount of biomass, excavated earthen materials (including soil), fossil fuels, metal ores, mixed and complex products, non-metallic minerals, products from biomass, products from fossil fuels, products from metals, products from non-metallic minerals, and waste for final treatment and disposal imported (Tonnes)	Environment Live/Global Material Flows Database (2023)
Capital (CPT)	Gross fixed capital formation (% of GDP)	WDI (2023)
Labor (LBR)	Labor force, total	WDI (2023)

$$GER_{it} = \beta_0 + \beta_1 RCE^{*}TECH_{it} + \beta_2 X_{it} + \varepsilon_{it} \tag{1}$$

Where *RCE*TECH* represent the resource exchange*technological advancement and the other variables remain the same as in equation (1).

Given that panel data is associated with unobserved individual differences that can influence the dependent variable. We use fixed effects to account for these unobserved individual-specific characteristics, such as natural endowment or cultural factors (Brüderl and Ludwig, 2015). As is typical in panel data, the dependent variable may influence one of the independent variables, which can result in endogeneity. In the presence of endogeneity, results may be biased and present inconsistent parameter estimates, undermining the reliability of the results (Clougherty et al., 2016). However, by incorporating fixed effects for individual units, the fixed effect model can control for time-invariant unobserved heterogeneity, which may help reduce endogeneity. In addition, we included the lag of the dependent variable in the model. This has been the standard approach for controlling endogeneity in models (Bollen and Brand, 2010).

4. Results and discussion

4.1. Pre-regression analysis

Table 2 presents the descriptive statistics, which reveal that the green economic recovery variable (−5.594) exhibits a negative value. This negative value suggests a decrease or contraction in economic indicators related to environmental sustainability or the endeavour to shift towards an ecologically friendly economy. The states are actively engaged in the exportation of resources, while the selected nations are seeing a decline in resource imports. The unit root analysis, as presented in Table 3, reveals that all variables, except green economic recovery and capital, exhibit evidence of a unit root. At first difference, it is important to note that all variables, namely green economic recovery, resource commodities trade (including resource commodities export and import), capital, and labor, exhibit stationary characteristics.

Table 2
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
GRE	2021	−5.594	11.333	−34.333	7.672
RCE	2021	0.03	1.274	−1.211	2.869
RCEP	2021	0.04	0.439	−0.443	1.06
RCIP	2021	−0.01	0.838	−0.841	1.836
CPT	2021	20.67	2.214	16.858	25.788
LBR	2021	5438562.5	2029768.4	2315524.9	9472933.3

4.2. Main results

The main findings are presented in Table 4, which provides evidence that trade in resource commodities exhibits a statistically significant negative effect (−15.96***) at the 1% significance level. This suggests that trade promotes the green economy's recovery. This is consistent with the intuition that African countries depend on natural resources such as coal, oil, and various commodities, which contribute to environmental degradation and climate change. The extraction, processing, and transportation of resource commodities have various environmental consequences, including but not limited to deforestation, habitat loss, river pollution, and air pollution. The potential benefits of green investments and activities may be undermined by the negative consequences associated with them. This finding is partly consistent with the findings of Hasan and Du (2023), who posits that the presence of trade blocs hinders the potential of natural resources to facilitate a sustainable economic recovery.

The coefficient for resource export (−36.56***) exhibits a negative and statistically significant relationship at the 1% level. This implies that the exportation of resource commodities is associated with a decrease in the progress of green economic recovery. This is also consistent with the intuition that the extraction of resources, particularly in the mining and oil sectors, has the potential to cause environmental degradation. This is contrary to our expectation that sustainable economic recovery focuses on environmental conservation and resource efficiency. This is also partly contrary to the finding of Isham et al. (2005), who find that resource-exporting countries tend to have more leverage in promoting economic growth.

However, the coefficient of resource commodity import (24.64) exhibits a positive and statistically significant relationship at the 1% significance level. This suggests that resource commodity imports are associated with an improved economic recovery system. One potential reason is that the importation of resources enables African nations to acquire advanced green technology, like renewable energy systems,

Table 3
Im-Pesaran-Shin unit-root test.

Variables	Level	1st difference
	Z-t-tilde-bar	Z-t-tilde-bar
GRE	−11.537[a]	−25.732[a]
RCE	32.190	−25.933[a]
RCEP	18.576	−31.866[a]
RCIP	37.999	37.999[a]
CPT	−5.319[a]	−23.147[a]
LBR	57.842	−21.211[a]

Standard errors in parentheses.
**$p < 0.05$, *$p < 0.1$.
[a] $p < 0.01$.

Table 4
Fixed-effect results (Dpv: GRE).

Variables	(1)	(2)	(3)
	GRE	GRE	GRE
RCE	−15.96[a]		
	(0.175)		
RCEP		−36.56[a]	
		(0.621)	
RECIP			24.64[a]
			(0.260)
CPT	0.714[a]	0.108[b]	0.857[a]
	(0.035)	(0.044)	(0.035)
LBR	0.001[a]	0.001[a]	0.001[a]
	(0.001)	(0.001)	(0.001)
Constant	−95.25[a]	−71.36[a]	−99.49[a]
	(1.140)	(1.371)	(1.142)
Observations	2021	2021	2021
R-squared	0.949	0.903	0.952
Number of ID	43	43	43

Standard errors in parentheses.
*p < 0.1.
[a] p < 0.01.
[b] p < 0.05.

Table 5
Fixed effect results of the moderating effects (Dpv: GRE).

Variables	(1)	(2)	(3)
	GRE	GRE	GRE
RCE	−12.15[a]		
	(0.314)		
RCE[b]TECH	0.004[a]		
	(0.003)		
RCEP		−22.66[a]	
		(1.223)	
RCEP[b]TECH		0.016[a]	
		(0.001)	
RCIP			18.74[a]
			(0.454)
RCIP[b]TECH			0.007[a]
			(0.004)
CPT	0.596[a]	0.001	0.725[a]
	(0.034)	(0.043)	(0.034)
LBR	0.001[a]	0.001[a]	0.001[a]
	(0.001)	(0.001)	(0.010)
Constant	−90.20[a]	−66.39[a]	−94.07[a]
	(1.141)	(1.370)	(1.134)
Observations	2021	2021	2021
R-squared	0.954	0.911	0.957
Number of ID	43	43	43

Standard errors in parentheses.
**p < 0.05.
[a] p < 0.01.
[b] p < 0.1.

energy-efficient appliances, and sustainable agricultural techniques. These technologies play a crucial role in facilitating the shift towards a more sustainable economy. Furthermore, the act of importing sustainable materials, components, and equipment can play a significant role in fostering a more environmentally conscious and economically varied society. This finding is partially inconsistent with Gylfason and Zoega (2006), who find a negative relation in the case of trade dependence of natural resources and economic growth.

The control variables exhibit consistency with theoretical expectations. Specifically, the coefficients associated with capital and labor demonstrate positive and statistically significant relationships, indicating that capital and labor play a crucial role in promoting the green economic recovery in Africa.

4.3. Mediating impact of technological innovation on green economic recovery

According to the findings presented in Table 5, there is a statistically significant negative association between resource trade and green economic recovery. The coefficient for resource trade is −12.15***, showing that an increase in resource trade is linked to a drop in green economic recovery. This relationship is significant at the 1% level. However, the coefficient of the variable representing the relationship between resource trade and technological innovation (0.004***) exhibits a positive and statistically significant association at a significance level of 1%. This suggests that technological innovation plays a crucial role in enhancing resource trade in promoting a green economic recovery. The connection between technological advances and enhanced resource utilization, waste reduction, and environmental effect mitigation is intuitive. This has the potential to facilitate a more environmentally sustainable economic recovery by maximizing the value derived from traded resources while simultaneously avoiding their adverse environmental consequences. This finding is partly consistent with Wang and Tao (2019), who find that technology import is associated with improving economic growth.

The implementation of innovative production technologies that prioritize health and well-being can significantly improve the environmental performance of companies that heavily rely on natural resources. The reduction of carbon footprint associated with traded resources can be achieved through the implementation of environmentally friendly production methods, the use of renewable energy sources, and the establishment of sustainable waste management techniques. Technological advancements, such as blockchain, the Internet of Things (IoT), and data analytics, have the potential to enhance the transparency and provenance of supply chains. This technique contributes to the promotion of responsible and sustainable sourcing of resources, thereby reducing the probability of engaging in ecologically harmful actions.

Furthermore, the integration of technical breakthroughs can play a pivotal role in expediting the shift towards a circular economy by enabling the efficient utilization of resources through processes such as resource reuse, remanufacturing, and recycling. This practice mitigates the necessity for ongoing resource extraction and effectively eliminates waste generation. The aforementioned findings are consistent with the study conducted by Vu et al. (2023), which demonstrated that the presence of innovation has an impact on the role played by natural resources in the process of economic recuperation.

In the second column, the coefficient of resource export (−22.66***) exhibits a negative sign and demonstrates statistical significance at the 1% level. This suggests that resource export is associated with declining green economic recovery. However, the coefficient associated with the moderating variables of resource export and innovation in technology (0.016***) exhibits a positive and highly significant relationship at the 1% level. This suggests that technological innovation plays a crucial role in promoting the export of resources and facilitating the advancement of green economic recovery. The correlation between technical innovation and the influence of resource exports on the shift towards a greener and more sustainable economy aligns with intuition.

The coefficient of resource import (18.74***) exhibits statistical significance at the 1% level and demonstrates a positive relationship in the third column. In a similar vein, the coefficient of the moderating variable representing resource import and innovation in technology (0.007***) exhibits a positive and highly significant relationship at the 1% level. This suggests that technological innovation has a discernible impact on the influence of resource import in Africa's pursuit of green economic recovery. This is consistent with the intuition that advancements in technology have the potential to improve the ability to track and disclose information about supply chains. This, in turn, can help guarantee that imported resources are obtained in a manner that is both sustainable and ethical. The results are consistent with our expectations. The coefficients of capital and labor exhibit positive and statistically significant values, suggesting that capital and labor are associated with increasing green economic recovery.

4.4. Endogeneity check

Panel data is often associated with endogeneity issues, which can lead to biased results. To address the issue of endogeneity, we employ the conventional method by including a lagged dependent variable in our model. The findings of the endogeneity test are presented in Table 6, revealing that the coefficients for resource trade and resource export exhibit a negative and statistically significant relationship with green economic recovery. This suggests that there is an association between resource trade, resource export, and a decrease in green economic recovery. However, the coefficient of resource import exhibits a positive and statistically significant relationship, suggesting that the expansion of green economic recovery relates to the import of resources. The results are consistent with the main results in Table 4, indicating that our model is unaffected by endogeneity.

Table 6
Fixed effect results with a lag of GRE (Dpv: GRE).

Variables	(1)	(2)	(3)
	GRE	GRE	GRE
RCE	−2.037[a]		
	(0.277)		
RCEP		−1.116[b]	
		(0.508)	
RCIP			4.034[a]
			(0.423)
L.GRE	0.814[a]	0.894[a]	0.785[a]
	(0.0152)	(0.0112)	(0.0152)
CPT	0.135[a]	0.0366	0.190[a]
	(0.0264)	(0.0228)	(0.0276)
LBR	1.79e-06[a]	4.40e-07[a]	2.28e-06[a]
	(2.30e-07)	(1.49e-07)	(2.30e-07)
Constant	−12.73[a]	−2.836[a]	−16.83[a]
	(1.675)	(1.036)	(1.729)
Observations	1978	1978	1978
R-squared	0.977	0.976	0.977
Number of ID	43	43	43

Standard errors in parentheses.
*$p < 0.1$.
[a] $p < 0.01$.
[b] $p < 0.05$.

5. Conclusion and policy implications

5.1. Conclusion

This study examines the relationship between resource trade and the endeavour to achieve a sustainable economic recovery. Given a detailed dataset, empirical analysis has been conducted to uncover the various issues arising from the resource trade dynamics and environmental sustainability. The findings of this study provide insight into significant patterns and trends that necessitate thoughtful deliberation among policymakers, economists, and environmental proponents.

The empirical findings highlight the capacity of countries abundant in natural resources to leverage their competitive advantage and shift their export focus towards environmentally friendly technologies and sustainable enterprises. Furthermore, our study uncovered compelling evidence suggesting that countries reliant on resource imports possess the ability to utilize their need for resources to incentivize exporting nations to embrace and implement production strategies that are more environmentally sustainable.

5.2. Policy implications

The findings of our study have a significant impact on policymakers who are responsible for guiding economies toward sustainable and environmentally friendly paths of economic recovery. Based on the findings, we propose the following policy recommendations. Firstly, African nations should investigate various strategies aimed at diversifying their resource portfolios and enhancing their industrial sectors to achieve long-term and sustainable economic growth. Promoting increased investments in research and development about environmentally friendly technology will effectively expedite the process of transitioning towards more sustainable resource exports.

Second, African states reliant on resource imports consider integrating environmental provisions into their trade agreements. This strategic approach aims to encourage resource-exporting partners to embrace sustainable practices. This encompasses strategies for overseeing and ensuring compliance with mutually agreed-upon ecological benchmarks.

Third, the states should engage in resource export and import to emphasize allocating resources toward developing sustainable infrastructure that facilitates resource-efficient methods of production and consumption. The scope of this can encompass a variety of initiatives, including programs related to renewable energy and the development of transportation networks that prioritize environmental sustainability. Fourth, the involvement of multiple nations in collaborative efforts has significant importance in disseminating optimal strategies for managing and trading sustainable resources. Efforts aimed at bolstering technical competence and facilitating knowledge exchange among nations have the potential to expedite the widespread adoption of environmentally sustainable practices.

The present study thoroughly examined the impact of natural resource trading on economic recovery. Future investigation can be undertaken by expanding the scope of the study, as the insufficient data constraints the extension of the current study.

CRediT authorship contribution statement

Abdulrasheed Zakari: Methodology, Data curation, Conceptualization. **Vincent Konadu Tawiah:** Writing – review & editing, Writing – original draft, Supervision. **Stefania Pinzon:** Conceptualization, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

References

Ahakwa, I., Xu, Y., Tackie, E.A., Odai, L.A., Sarpong, F.A., Korankye, B., Ofori, E.K., 2023. Do natural resources and green technological innovation matter in addressing environmental degradation? Evidence from panel models robust to cross-sectional dependence and slope heterogeneity. Resour. Pol. 85, 103943.
Awosusi, A.A., Adebayo, T.S., Altuntaş, M., Agyekum, E.B., Zawbaa, H.M., Kamel, S., 2022. The dynamic impact of biomass and natural resources on ecological footprint in BRICS economies: a quantile regression evidence. Energy Rep. 8, 1979–1994.
Better, A.B.B., 2022. Green recovery for global economic growth: embracing the opportunity and redefining prosperity. Indonesia Post-Pandemic Outlook: Social. Perspect. 57.
Bollen, K.A., Brand, J.E., 2010. A general panel model with random and fixed effects: a structural equations approach. Soc. Forces 89 (1), 1–34.
Brüderl, J., Ludwig, V., 2015. Fixed-effects Panel Regression. The Sage handbook of regression analysis and causal inference, pp. 327–357.
Clougherty, J.A., Duso, T., Muck, J., 2016. Correcting for self-selection based endogeneity in management research: review, recommendations and simulations. Organ. Res. Methods 19 (2), 286–347.
Dimitratos, P., Jones, M., 2010. Resources, Efficiency and Globalization. Springer.
Enzmann, P., Moesli, M., 2022. Seizing opportunities: ASEAN country cluster readiness in light of the fourth industrial revolution. Asia and the Global Economy 2 (1), 100021.

Gu, X., Alamri, A.M., Ahmad, M., Alsagr, N., Zhong, X., Wu, T., 2023. Natural resources extraction and green finance: Dutch disease and COP27 targets for OECD countries. Resour. Pol. 81, 103404.

Gylfason, T., Zoega, G., 2006. Natural resources and economic growth: the role of investment. World Econ. 29 (8), 1091–1115.

Hao, Y., Huang, J., Guo, Y., Wu, H., Ren, S., 2022. Does the legacy of state planning put pressure on ecological efficiency? Evidence from China. Bus. Strat. Environ. 31 (7), 3100–3121.

Hasan, M.M., Du, F., 2023. The role of foreign trade and technology innovation on economic recovery in China: the mediating role of natural resources development. Resour. Pol. 80, 103121.

Hassoun, A., Prieto, M.A., Carpena, M., Bouzembrak, Y., Marvin, H.J., Pallares, N., Barba, F.J., Bangar, S.P., Chaudhary, V., Ibrahim, S., 2022. Exploring the role of green and Industry 4.0 technologies in achieving sustainable development goals in food sectors. Food Res. Int. 112068.

Hsu, C.-C., Chau, K.Y., Chien, F., 2023. Natural resource volatility and financial development during Covid-19: implications for economic recovery. Resour. Pol. 81, 103343.

Isayev, S., Qodirov, Z., Oripov, I., Bobirova, M., 2022. Effects of resource-efficient irrigation technologies in irrigation of sunflowers on land hydrogeological conditions. British Journal of Global Ecology and Sustainable Development 4, 95–100.

Isham, J., Woolcock, M., Pritchett, L., Busby, G., 2005. The varieties of resource experience: natural resource export structures and the political economy of economic growth. World Bank Econ. Rev. 19 (2), 141–174.

Khan, S.A.R., Ponce, P., Yu, Z., Golpîra, H., Mathew, M., 2022a. Environmental technology and wastewater treatment: strategies to achieve environmental sustainability. Chemosphere 286, 131532.

Khan, S.A.R., Ponce, P., Yu, Z., Ponce, K., 2022b. Investigating economic growth and natural resource dependence: an asymmetric approach in developed and developing economies. Resour. Pol. 77, 102672.

Livingstone, L., Börkey, P., Dellink, R., Laubinger, F., 2022. Synergies and Trade-Offs in the Transition to a Resource-Efficient and Circular Economy.

Ponce, P., Yunga, F., Larrea-Silva, J., Aguirre, N., 2023. Spatial determinants of income inequality at the global level: the role of natural resources. Resour. Pol. 84, 103783.

Sekhri, S., 2022. Agricultural trade and depletion of groundwater. J. Dev. Econ. 156, 102800.

Taranic, I., Behrens, A., Topi, C., 2016. Understanding the circular economy in Europe, from resource efficiency to sharing platforms: the CEPS framework. CEPS Special Reports 143.

Torugsa, N.A., O'Donohue, W., Hecker, R., 2013. Proactive CSR: an empirical analysis of the role of its economic, social and environmental dimensions on the association between capabilities and performance. J. Bus. Ethics 115, 383–402.

Usman, M., Balsalobre-Lorente, D., 2022. Environmental concern in the era of industrialization: can financial development, renewable energy and natural resources alleviate some load? Energy Pol. 162, 112780.

Vu, T.L., Phan, T.T.H., Sadiq, M., Xuyen, N.T.M., Ngo, T.Q., 2023. Nexus of natural resources, urbanization and economic recovery in Asia: the moderating role of innovation. Resour. Pol. 81, 103328.

Wang, K., Tao, W., 2019. Exploring the complementarity between product exports and foreign technology imports for innovation in emerging economic firms. Eur. J. Market. 53 (2), 224–256.

Wang, Q., Wang, S., 2022. The impact of environmental regulation on water resources utilization efficiency. Front. Environ. Sci. 10, 1022929.

Xu, X., 2000. International trade and environmental regulation: time series evidence and cross section test. Environ. Resour. Econ. 17, 233–257.

Yu, Z., Khan, S.A.R., Ponce, P., Muhammad Zia-ul-haq, H., Ponce, K., 2022. Exploring essential factors to improve waste-to-resource recovery: a roadmap towards sustainability. J. Clean. Prod. 350, 131305.

Zakari, A., Khan, I., Tawiah, V., Alvarado, R., Li, G., 2022. The production and consumption of oil in Africa: the environmental implications. Resour. Pol. 78, 102795.

Zhang, Y., Dilanchiev, A., 2022. Economic recovery, industrial structure and natural resource utilization efficiency in China: effect on green economic recovery. Resour. Pol. 79, 102958.