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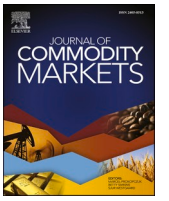

The role of financial development in enhancing trades in environmental goods: International insights from 119 countries

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ABSTRACT

This paper attempts to empirically examine the influences of financial development (*FIN*) on the trade in environmental goods (*TEG*). Through the application of diverse econometric techniques to a global sample of 85 developing and 34 developed countries from 2000 to 2019, the estimation results demonstrate that the financialization captured by nine indices from the Financial Development Index database has a light influence on the trade values of environmental goods. The development of both financial institutions and market positively influences the trade activities of environmental goods, but financial institutions' role is more critical. We find robust results by utilizing various econometric techniques and adding more explanatory variables. Furthermore, there is evidence on the long-term cointegration between financial development and *TEG,* and our results confirm its effects in the long term. Finally, the nexus between the two samples: developing and developed countries, but the importance of both financial institutions is more evident, especially in the developed countries. Finally, the effects of uncertainty or risk on *TEG* value become less sizable if these economies have a well-developed financial system.

1. Introduction

Environmental concerns remain one of the five most hazards in the world in terms of the probability and repercussions, according to the 2017 Global Risks Report, while the 2021 Global Risks Report states that rising problems have brought about new global concerns (The Global Risks Report 2021). The importance of protection of the environment is getting more and more awareness by firms, especially regarding developing and maintaining a long-term competitive advantage. As a result, environmental protection is regarded to be one of their operating criteria, according to Kim (2018). In addition, Żelazna et al. (2020) contend that firms are gaining more attention to environmental issues, such as ecological preservation, air quality, resource stability, and sustainability providing a safe and green environment. Many strategic organizational executives acknowledge that firms' activities towards emission regulations cause their expenses and revenue as well as credibility and competitive advantages are all favorably and significantly influenced (Liu et al., 2019). Consequently, successful methods, including workplace recycling, sustainable community development, sustainability committee formation, and new digitization trends have been implemented by many businesses. The role of environmental protection become much more critical than ever in the contemporary setting of industrial and urban growth (Patnaik, 2018).

It is widely acknowledged that the promotion of activities of environmental goods is essential in lowering emissions by stimulating economic development, shifting manufacturing towards environmentally friendly goods, as well as enhancing the transmission and adoption of technological improvements (Zugravu-Soilita, 2018). In this manner, the pursuit of trade in environmental goods (TEG) is

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considered as a vital target to help the economies achieve sustainable development (Ha and Thanh, 2022). TEG refers to trading activities of green or environmental goods, which do not harm the ecological quality (Doan and Ha, 2022). The list of goods defined as TEG is provided by different international associations. In this article, we employ Combined List of Environmental Goods (CLEG including 248 products). For a robustness check, we also employ alternative lists, namely Core List of Environmental Goods (CoreCLEGPLUS including 40 products), Plurilateral Environmental Goods and Services (PEGS including 150 products), and the Asian-Pacific Economic Cooperation (APEC) list of environmental goods, which include 54 products benefiting applied tariff rate to 5% or less. Nonetheless, there are very few investigations on antecedents of TEG. Exceptions are Cantore and Cheng, 2018a; Cantore and Cheng, 2018b, de Melo and Solleder (2020) and Ha and Thanh (2022). Cantore and Cheng, 2018a; Cantore and Cheng, 2018b concentrate on the impact of stricter environmental regulations, while de Melo and Solleder (2020) investigate the role of the removal of barriers and non-tariff barriers. More recently, Ha and Thanh (2022) explain the role of the digital transformation process in promoting environmental goods trades.

In this paper, we concentrate on the role of financial development in enhancing TEG. Even though the literature has indicated the link between financialization and trades in conventional goods (Beck, 2002; Dar and Asif, 2018; Do and Levchenko, 2004; Leibovici, 2021), it is unreasonable to accept the theoretical and empirical analysis of conventional goods to environmental goods. It is uncertain which nations should engage in the export of environmental commodities since this type of goods has a tendency to be more complicated than traditional goods (Ha and Thanh, 2022). TEG is a combination of international transactions and environmental issues that help countries pursue sustainable development. Furthermore, the tastes and behavior of customers with demands and requirements for friendly-environmental products are significantly different from those in the traditional markets. Therefore, it is imperative to have more studies exploring drivers of TEG in general and the specific influences of financial development.

In the literature, prior scholars indicate that financial development influences countries' international transactions and environmental quality. However, these papers have demonstrated inconsistent findings on the effects of financialization. The environmental quality is more likely to decrease when there is an improvement of financial development (Ahmad et al., 2021; Shahbaz et al., 2018), while Shobande and Ogbeifun (2022) contend that the beneficial effects of financialization only appear for countries featured a high level of human capital or well-developed institutional system. Some scholars report the positive effects of financialization in the long run, while the similar evidence cannot be found in the short-run (Dar and Asif, 2018). The scholars reveal a relationship between financial development and energy intensity (Canh et al., 2020; Le et al., 2020a,b; Wiser and Pickle, 1998) and CO_2 emission (Le et al., 2020a,b). There is no paper investigating the role of financialization in enhancing TEG, and this paper is the first effort to explore the financialization-TEG nexus.

In this paper, we believe that there exists a nexus between financialization and trade in green commodities. The reasons are as follows. First, the literature reveals that credit limitations or financial constraints cause exporters to move toward low-quality commodities (Fan et al., 2015). Since penetrating into new markets or trading new goods requires substantial upfront expenditures (Hoffman et al., 2016) and makes firms encounter increased risk exposure (Jones et al., 2011), trade quality and diversification are more likely to be affected by financialization. Second, prior scholars contend that financial development plays a critical role in resolving environmental issues. In particular, previous studies indicate the link between financialization, carbon intensity, energy demand (Farhani & Ozturk, 2015), and CO_2 emissions (Shahbaz et al., 2018). It is widely affirmed that financial development facilitates the provision of financial means (or access to financial resources) for business growth (Al Mamun et al., 2018) or technological advancement (Adams and Klobodu, 2018), the transition to renewable energy (Ali et al., 2018) or energy efficiency (Chen et al., 2019). Hence, we have evidence to strongly believe that the development of the financial system can promote the trading activities of green goods.

To implement our research, we utilize bilateral trade in the Combined List of Environmental Goods (CLEG) list obtained from the UN Comtrade database with the six-digit level of the 2007 version of the Harmonized System (HS 2007) and nine indicators from the Financial Development Index database to reflect the financial development. By using tests, we indicate a presence of cross-sectional dependence in our sample therefore, the panel corrected standard errors (PCSE) model is applied throughout the paper. To confirm the accuracy and robustness of our findings, we also employ the feasible generalized least square estimates (FGLS) model that considers the presence of heteroscedasticity and fixed effects and the two-step generalized method of moment (two-stem GMM) that take the endogeneity arising from financialization and TEG variables into account. To further resolve endogeneity, all independent variables in the model are lagged by one year. The lag-pooled mean group autoregressive distributed lag (PMG-ARDL) method is also considered to measure financial development and TEG's short-run and long-run effects. To shed light on the nexus between financialization and TEG, a similar empirical examination is conducted for three subsamples by income levels, including developing and developed countries. A similar empirical approach and estimation procedure are replicated for subsamples of 85 developing and 34 developed countries. Lastly, we examine the role of the well-developed financial system in resolving adverse influences of global uncertainty and risks.

We contribute to the current literature in several ways. First, we are the first to exploit the role of a well-developed financial system in promoting the trade activities of environmental goods that connects two strands of the literation: international trade and environmental quality. Our results stress the key findings from these two strands of the literature. We contribute a vital point to the literature by demonstrating that financial development is a critical driver of TEG. Second, we point out empirical evidence on the long-term cointegration between financialization and TGG. The association becomes substantially sizable in the case of developed countries. Furthermore, there is evidence on the long-term cointegration between financial development and *TEG,* and our results confirm its effects in the long term. Second, we confirm that our findings are robust and reliable by using various methods such as different measures of *TEG*, different econometric techniques to control any possible issue arising from the database, and different samples of developing and developed economies.

The remaining of this paper includes four parts. Section 2 develops theoretical backgrounds and hypotheses. Section 3 interprets

data and model specifications. Section 4 portrays the empirical results and discussion. Section 5 concludes the study.

2. Literature review

2.1. Trade in green goods

Since the standard of living has risen rapidly in a wide range of nations, worldwide ecological stresses have risen as well, despite some progress in decoupling economic growth from contamination. Many locations, including Africa, Australia, many portions of South America, the southern part of Europe, as well as the United States, are expected to face increased water supply constraints in the upcoming years (World Bank, 2012). Faced with such rising issues, authorities in both developing and developed countries have been prompted to take immediate steps to mitigate the negative consequences of economic activity on the environment both regionally and worldwide. Green rules are currently being utilized by authorities to influence manufacturing or consumption patterns to address challenges, including regional environmental pollution as well as greenhouse gas emissions. Government policy is anticipated to compel private players to factor in societal charges in their selection making. Compliance with environmental standards requires the use of modern methods and know-how that are frequently beyond the capabilities of businesses. As governments become more likely to confine their environmental rules, environmental standards generate a trade for environmental commodities that is more transnational in reach.

A lot of economic benefits, such as increased efficiency, scalability, and better access to environmentally friendly technology, are delivered by introducing marketplaces for environmental goods. Achieving desired sustainability goals, such as freshwater sources, reduced air pollution, and more efficient natural resource distribution, is also supported. To sustain those gains, officials have taken steps to democratize TEG further. In particular, they reduce tariffs and remove other trade obstacles. Nevertheless, suppose they only rely on trade openness. In that case, they may not be able to encourage polluting businesses to acquire pollution-reducing or environmentally benign finished products, mainly if the economy cannot absorb external consequences. According to the field of strategic management, climate regulations are the most effective means to compel companies to adopt eco-friendly lifestyles and innovations. Technologies and competitiveness are fostered by environmental standards (Porter and van der Linde, 1995). The evidence for a link between environmental initiatives and economic success is also highlighted in the literature. Claver et al. (2007) provide anecdotal proof that pro-environmental efforts can improve a company's reputation and success. Environmental laws appear to have a positive impact on innovation in European industrial sectors (Rubashkina et al., 2015). Meanwhile, according to Costantini and Mazzanti (2012), the degree of pollution prevention and emission reduction efforts in high-tech industries are impacted by environmental regulation.

2.2. Financial development and trade in environmental goods

The relationship between financial development and international trade is investigated in the literature. In particular, Beck (2002), Leibovici (2021) and Manova (2013) are among the primary research studies on this link. They document that a larger trade flow is associated with a better financial market, especially in financially dependent sectors. According to Chiang and Masson (1988), trade diversification and quality are essential for economic development because they are indicators of a country's success (Krishna and Maloney, 2011) and prosperity (Lages et al., 2009). In addition, previous studies reveal that variations in trade quality and diversification have been linked to economic indicators. For example, it is suggested by Acharyya and Jones (2001) that income redistribution measures must accompany direct trade quality rules because trade quality policies might exacerbate income disparity. Additionally, Rankin & Schöer (2013) believe that trade location is connected to product quality, which can result in wage differences in South African exporting enterprises. In the case of Colombia, Brooks (2003) observes that the quality of the product is the main factor of making international transactions of industrial products to the United States between 1981 and 1991. A substantial link between trade quality and trade agreements in a sample of 60 nations in 1995 is also found by Hallak (2006). He points out that high-income countries producing higher-quality products can gain a high level of trade values. Take Italy as an example, where a negative relationship between a company's growth and trade proportion to low-income countries is found by Crinò and Epifani (2012). A connection between enterprises' research and development (R&D) activity and their trade proportion to low-income countries is also identified. Studies on the variations of trade quality and diversification, in other words, are critical for both researchers and policymakers (Donnenfeld and Mayer, 1987).

However, from the view of microeconomic research, improving product quality, especially a production of environmental goods is constrained by budgetary restrictions (Fan et al., 2015). When investigating French industrial exporters from 1997 to 2000, Bernini et al. (2015) establish a negative association between a firm's debt and trade quality. Fan et al. (2015) propose a quality sorting framework to analyze the link between credit limitations and product quality selection among exporting enterprises. Firms with tighter financing limitations often produce lower-quality items. Empirical findings in China support this hypothesis. Credit limitations may have a more significant impact on trade quality and diversification when internationalization occurs because penetrating into new markets or trading new goods requires substantial upfront expenditures (Hoffman et al., 2016) and make firms encounter increased risk exposure (Jones et al., 2011). Moreover, leaders of exporting firms are subject to perverse incentives (García-Alonso et al., 2004), which encourages them to direct the firm's output toward low-quality commodities if credit limitations are encountered. In general, we believe financial development plays an essential role in trade diversification and quality dynamics. A significant correlation between financialization and trade diversification and quality can be predicted by inserting macroeconomic elements into the quality sorting model proposed by Fan et al. (2015). According to Svirydzenka (2016), the economy can benefit from lower-cost capital and financial

services reduce credit limits from a greater degree of financial development.

In addition to examining the connection between financialization and trade, researchers have devoted considerable attention to financialization's role in addressing the issue of environmental change and especially its impact on energy consumption. This role encourages to use modern machines to produce friendly environmental goods. There is evidence for links between financial development, foreign direct investment, carbon intensity, and energy demand in Tunisia, for instance Farhani and Ozturk (2015). A growing influence of financial development on CO_2 emissions in the United Arab Emirates is discovered by Shahbaz et al. (2018). According to a literature review on the subject, the influence of financial development on fuel/energy efficiency has received relatively little attention. A review of this link also makes us realize the shortage of research on the effects of financialization on trade activities of environmental goods.

On the one hand, Blackburn and Hung (1998) state, for example, that a fundamental aspect of the institutional framework is the financialization of the economy. The reason is that financial development facilitates the provision of financial means (or access to financial resources) for business growth (Al Mamun et al., 2018). An increase in usage, investment, and output may worsen power consumption and concentration. It is suggested by several studies, for example, Adams and Klobodu (2018) on 26 African nations (1985–2011), that financial development has a favorable influence on energy usage. Financial development, on the other hand, is believed to make a significant contribution in technological advancement and energy utilization change. For example, financial development is stated in some studies, including the case of 19 Asia Cooperation Dialogue member nations (Ali et al., 2018), to play a crucial role in the transition to renewable energy. The impact of financial development on energy efficiency is also investigated. According to Chen et al. (2019), financial development has a considerable negative influence on non-OECD nations' energy intensity. Meanwhile, in OECD countries, it has only a negligible influence on energy reduction. Energy intensity in Bangladesh is believed by Pan et al. (2019a,b) to be casually influenced by financial development, but the influence has since decreased. Pan et al. (2019) also find that financial development aids in shaping energy intensity in Bangladesh. Hence, the technological advancement leads to a rise in produced environment goods that can be served locally and globally. Financialization also promote the trend of goods using less energy or emitting less pollution.

In this paper, we consider environmental goods to be high-quality, financially dependent goods. Countries with a well-developed financial system have a high capacity for producing environmental goods. The development of the financial system also allows countries to use energy/fuels more efficiently, making them less energy or resource dependent, thus less likely impacting the environmental quality.

Based on our discussion, we hypothesize that:

H1. Financial development has a positive influence on the trade in environmental goods.

It is generally recognized that there are two main sub-sectors of the finance sector - financial institutions (for example, insurance companies, banks, funds, and other types of non-bank financial institutions) and financial markets (for example, bond and stock markets). According to Svirydzenka (2016), they perform different functions in economic activities. Svirydzenka (2016) also highlights that the importance of financial institutions would be more significant in funding for a wider variety of economic agencies, including government and people. Meanwhile, firms' and institutional organizations' investment activities tend to be supported by financial markets. This means that the influence of financial institutions and financial markets on fuel/energy efficiency and the environment may be uneven.

On the other hand, Canh et al. (2020) state financial development is qualified by using simple proxies. For example, private credit and stock market capitalization are used by Maskus et al. (2019). In addition, Cavalcante et al. (2018) use money supply, Shahbaz et al. (2018) use private sector credit, and Yang (2019) use stock trading and stock market capitalization. However, having a comprehensive assessment of financial development that covers all aspects of financialization is critical. The study of Nasir et al. (2019) on ASEAN nations is one of the recent papers that attempted to incorporate more than one indicator of financial development. Financial depth (i.e., the size and liquidity of markets), financial availability (i.e., the ability of individuals and businesses to use financial services), and financial efficiency (i.e., the ability of financial institutions to provide low-cost, long-term financial services, and the amount of capital market activity) are three aspects of each element or sub-sector of the financial sector, according to Svirydzenka (2016). Energy intensity can be encouraged because financial depth and availability eliminate financial limitations and offer resources for most economic agencies. Financial efficiency, on the other hand, may be a helpful factor toward increased energy efficiency since it offers funding at reduced prices. This can be a significant indicator for technical advancement and energy transformation, both of which are hampered by the expensive transforming process. As a result, financial efficiency is expected to significantly contribute to a rise in produced environmental goods or goods using less energy and natural resource and emitting less pollution to the environment.

According to economic theories, financialization is one of the crucial factors of economic growth (Levine, 1997), because of its critical functions in transporting cash and providing financial services (Levine, 1997). In this regard, Capasso and Jappelli (2013) believe financial development is a critical part of the whole institutional structure. Energy demand and energy supply can be in deprivation due to a lack of financial development. The well-developed financial sector is a key factor in enabling individuals to access energy and electricity on demand. Le et al. (2020a,b) found that financial development increased energy consumption.

Residents transitioning to clean energy, biomass cooking, and heating can obtain financing through the banking sector. For example, Le et al. (2020) demonstrate that the financial sector's evolution is an essential indicator of the adoption of renewable energy. The banking sector also changes customers' taste and awareness from brown commodities to green (environmental) commodities. On the supply side of energy generation, a vital role is played by financial development in the energy/electricity sector (Hall et al., 2016). Financial development may support the growth of electricity generation and transmission to deliver power to more residents. Because energy generation, particularly electric generation, and transmission, requires significant investments, it is complicated for developing

nations to do so and is considered as a financial restriction (Peng & Poudineh, 2017).

Most prior research on financial development employs a basic proxy like stock market capitalization or domestic credit supply (Maskus et al., 2019), expressing one component of financial growth (Svirydzenka 2016). Financial markets (for example, bond markets, stock markets, and by-passing traditional bank lending) and financial institutions (for example, insurance firms, banks, mutual funds, and other types of non-bank financial institutions) and are the two main sub-sectors or elements of the finance industry, according to Svirydzenka (2016) Additionally, following Svirydzenka (2016), each financial subsector has its own set of parameters relating to financial depth, access, and efficiency. We use financial depth to capture the liquidity and size of markets, financial availability to reflect the ability of firms or individuals to use financial services, and financial efficiency to present the ability of financial institutions to provide low-cost, long-term financial services, and the amount of capital market activity. Following these definitions, financial institutions may be a more vital source of funding for individuals in the process of eradicating energy poverty, and financial markets may be a valuable source of finance for large-scale electricity-related projects. For simplicity, financial depth as the size of markets and financial efficiency as the cost of financial services are essential for energy/fuel supply. In contrast, financial access representing the financial agents' capacity to supply financial services significantly affects the energy/fuel demands. Prior work has demonstrated that different levels of financial development have different effects on energy use. For example, Topcu and Payne (2017) discover that how financial development affects energy consumption is determined by how it is measured. It has been recently identified that three financial dimensions and two subsectors may have varying effects on energy intensity in production and consumption according to (Canh et al., 2020). By contrast, financial market depth raises natural resource rents, according to Canh et al. (2020), whereas financial institutions have the reverse impact.

It is critical to consider the catalyzing element in addition to using inclusive indicators of financial development. For example, it is advised by Bhattacharyya and Hodler (2014) that extra control variables, diverse samples, and alternative financial development metrics should be included in studies in financial development. Energy pricing can be considered one of the most critical determinants of power use because it affects energy cost. Greater power prices, therefore, would result in higher purchasing and manufacturing costs, which might cause a reduction in energy needs. On the contrary, higher costs may encourage adjustments in energy usage for manufacturing and utilization to achieve greater efficiency. Nevertheless, the literature indicates that the transition to more efficient or environmentally friendly energy sources is hampered by financial restrictions (Ji and Zhang, 2019). Financial restrictions also dampen the trend of consuming less energy-intensive products and less pollution-emitting products. In this case, an enhancement in financial development can help energy usage be more effective. Concomitantly, the subject study intends to analyze the multidimensional role of financial development in consumption energy intensity and production energy intensity and trends to consume environmental products.

Based on our discussion, we hypothesize that:

H2. The effect of financial institution development on trade in environmental goods is more sizable than those of financial market development.

2.4. Moderating role of global uncertainty

In the previous section, we argue that countries with a well-developed financial sector are more likely to trade in environmental goods as firms have more competitive capabilities to produce green goods, external stakeholders demand more environmental goods, and the government implements the stringency of environmental policy. In this section, we contend that global uncertainty may moderate the effect of economic complexity on trade in environmental goods due to the following reasons. To begin with, uncertainty causes enterprises to incur greater expenditures to be environmentally friendly. According to Chu & Hoang (2021), economic policy uncertainty has a moderating influence on the impacts of production knowledge on environmental quality. Meanwhile, Cantore and Cheng, 2018a; Cantore and Cheng, 2018b show that macroeconomic uncertainty impacts environmental goods trade negatively. In this manner, uncertainty acts as environmental goods ' trade friction.

The second point is that rising macroeconomic uncertainty may limit customer interest in green goods (Zhuang et al., 2021). According to Teng and Lu (2016), uncertainty reduces the impact of health awareness and ecological considerations on green goods purchasing intention. Furthermore, Lei et al. (2022) found that policy uncertainty affects clean energy usage. Thirdly, according to Porter (1980), more stringent environmental legislation encourages enterprises with higher technical levels to choose technology advancement to increase product competitiveness. Because green technology demands more incentive to invest, heightened risk, and a more unstable economic demand than previous techniques, firms whose primary goals are to seek profit are more likely to choose conventional advancements that provide instant profits and clear success in the market when making innovation decisions. Uncertainty in this sector decreases green innovation and green output, resulting in a decline in environmental goods trade.

We hypothesize the following based on the preceding discussion.

H3. The effect of financial development mitigates adverse effects of global uncertainty on trade in environmental goods.

3. Empirical methodology

We base on both the environment and trade literature to develop the model to examine the association between financial development (*FIN*) and trade in environmental goods (*TEG*). The theoretical model used to investigate the FIN-TEG nexus can be presented as follows:

$$lnTEG_{it} = \beta_0 + \beta_1 LFIN_{i,t-1} + \beta_3 LCONTROL_{i,t-1} + \varepsilon_{ijt,} \quad (1)$$

where subscripts i and t represent country i and year t, respectively.

Trade in Environmental Goods (TEG):

TEG is the value of the export of environmental goods. Data on trade activities in Combined List of Environmental Goods (CLEG) were taken from the UN Comtrade database using the six-digit level of the 2007 version of the Harmonized System (HS 2007). Values are all expressed in the current USD. This variable is taken a natural logarithm (*lnTEG*). To cover the years 1996–2019, the HS codes listed on the CLEG were converted from HS 2007 into HS 1996 by the UN Trade Statistics.[1] The CLEG includes 248 products. The information about the CLEG list is provided in Table A.2 in Appendix. We collect this information from different sources. In this analysis, we use trade values of 40 products selected with expert advice from Environmental Business International Inc (CoreCLEGPLUS) and 150 products with a focus on goods of relevance to combatting climate change from PEGS (Plurilateral Environmental Goods and Services), and 54 products benefiting applied tariff rate to 5% or less from APEC's list.

Key explanatory variable: Financial Development.

The key independent variable ($FIN_{i,t}$) in this paper is a natural logarithm of the overall financial index (*LFIN*), which is measured based on two sub-indices of financial development, including a natural logarithm of financial institutions (*LINFI*) and a natural logarithm of financial markets (*LINFM*). We follow Ha (2022a) and Svirydzenka (2016) to analyze these two sub-indices in three different aspects, including depth, access, and efficiency. Specifically, we have three corresponding variables: *LFINID, LFINIA,* and *LFINIE* for financial institutions and *LFINMD, LFINMA,* and *LFINME* for financial markets. These variables are available from the International Monetary Fund (IMF) database. $CONTROL_{i,t}$ is the set of control variables that their selection is based on previous works in the trade and environment literature. Particularly, we follow Aslam et al. (2017), Fu et al. (2020), Ha (2022b), Ha and Thanh (2022), Le and Hoang (2021) and Okah Efogo (2020) to consider the effects of nation's economic growth (*ECG*) measured by the real gross domestic product (*GDP*) per capita at the constant 2010 US dollars, the level of industrialization (*IDL*) measured as a share of value-added in the industry sector to GDP, nature rents (*NAR*) measured as a share of the sum of coal rents, mineral rents, natural gas rents, and forest rents, human capital (*HDI*) captured by the human capital index, level of democratization (*DEM*), net inflow of foreign direct investment (*INF*), tax rate (*TAX*), which is total tax and contribution tax rate measured a share of profits, and government effectiveness level (*GEI*) captured by the government effectiveness index. Except for the variable *DEM* collected from the Finnish Social Science Data Archive (FSSDA) and *GEI* collected from the World Bank Group Indicator (WBGI), we source the remaining control variables from the World Development Indicator (WDI). All these controlled variables are taken logarithm before adding into the model.

After merging and cleaning the country database, our final sample includes 119 countries, including 85 developing and 34 developed countries for the period 2000–2019 (see Table A.1 in Appendix for a description of included countries in our paper). Table 1 presents a statistical description of all variables. The results in Table 2 illustrate the correlation matrix between all variables. The results show a positive correlation between *FIN* and *TEG*.

From an econometric perspective, our study firstly employs the cross-sectional dependence (CD) tests developed by Pesaran (2021) to check for the existence of CD issues in our sample. Subsequently, we conduct the stationarity test of data with the existence of CD by applying the Levin-Lin-Chu unit-root test (Levin et al., 2002) and Im-Pesaran-Shin unit root test (Im et al., 2003). The test results are presented in Table 3, which shows that the issue of CD exists among included variables. Levin-Lin-Chu unit root tests and Im-Pesaran-Shin unit root tests suggest that some variables are stationary. We also apply similar tests for the first difference of included variables, and the stationarity is confirmed.

According to Beck and Katz (1995), Ha et al. (2021a,b) and Le and Hoang (2021), the panel corrected standard error (PCSE) model is adequately applied to the sample data characterized by a large number of countries (N) and small time-length (T) as well as the existence of CD and stationarity of first-difference variables. Besides, the one-year lag of all independent variables is applied to deal with an endogeneity resulting from the simultaneity between *TEG* and financial variables. The feasible generalized least square (FGLS) model is also employed to resolve heteroscedasticity as stated by Ha (2022b), Ha and Thanh (2022) and Liao and Cao (2013), while the two-step GMM is considered as an alternative method to resolve the issue of endogeneity (Gala et al., 2018; Ha et al., 2021; Sweet and Eterovic Maggio, 2015). Another concentration of this paper investigates the relationship between financialization and TEG in the short term and long term. For this purpose, we apply the autoregressive distributed lag (ARDL) method (Pesaran and Smith, 1995). The existence of cointegration between these two variables is checked firstly by using various tests, including the Kao cointegration test, Pedroni test, and Westerlund cointegration test. These are popular cointegration tests in the literature, respectively developed by Kao (1999), Pedroni (2004) and Westerlund (2005). The results of these tests are depicted in Table 4, implying a presence of the long-term cointegration between financial variables and *TEG*.

4. Empirical results

4.1. Baseline results

This study examines the relationship between financial development (*FIN*) and trade values of environmental goods (*TEG*). The estimation results are presented in Table 5. Financialization appears to be statistically significant and positive in our estimation model. This finding is consistent when we apply various econometric models, including the PCSE estimate, the PCSE estimate with more

[1] https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp.

Table 1
Description of variables.

Variable	Definition	Measure	Source	Obs	Mean	SD	Min	Max
LnTEG	Trade in environmental goods values	A natural logarithm of TEG values	UN Comtrade	2261	11.41	3.16	2.42	19.11
LFIN	The composite financial development index	A natural logarithm of composite financial development index	FIN-IMF	2261	−1.51	0.77	−3.55	−0.05
LFINI	Financial institutions development	A natural logarithm of financial institutions development	FIN-IMF	2261	−1.13	0.58	−3.06	−0.04
LFINM	Financial markets development	A natural logarithm of financial markets development	FIN-IMF	2185	−3.05	2.72	−24.52	−0.05
LFINID	Financial institution depth	A natural logarithm of financial institution depth	FIN-IMF	2261	−2.03	1.31	−11.65	0.00
LFINIA	Financial institution access	A natural logarithm of financial institution access	FIN-IMF	2261	−1.73	1.28	−5.45	0.00
LFINIE	Financial institution market efficiency	A natural logarithm of financial institution market efficiency	FIN-IMF	2261	−0.59	0.27	−2.15	−0.19
LFINMD	Financial market depth	A natural logarithm of financial market depth	FIN-IMF	2185	−2.77	2.44	−23.54	0.00
LFINMA	Financial market access	A natural logarithm of financial market access	FIN-IMF	1558	−2.19	1.76	−6.19	0.00
LFINME	Financial market efficiency	A natural logarithm of financial market efficiency	FIN-IMF	1216	−1.92	1.90	−11.07	0.00
ECG	Real output growth	A natural logarithm of real GDP per capital (constant 2010 US dollars)	WDI	2260	8.32	1.46	5.35	11.24
IDL	Industrialization level	Value-added of industry sector to GDP	WDI	2259	27.17	10.70	3.24	72.15
NAR	Natural rents	Share of the sum of coal rents, mineral rents, natural gas rents, and forest rents to GDP (%).	WDI	2261	7.00	10.08	0.00	58.65
HDI	Human capital	Log of human capital index.	WDI	2261	0.68	0.16	0.26	0.95
DEM	Democratization level	Index of democratization	FSSDA	2261	0.45	0.25	0.03	0.89
INF	Net inflow of foreign direct investment	Proportion of GDP	WDI	2119	−0.02	0.21	−2.92	1.61
TAX	Tax rate	Total tax and contribution tax rate (as the share of profit)	WDI	1604	48.87	39.00	7.40	339.10
GEI	Government effectiveness level	Government effectiveness index	WBGI	1640	5.65	2.28	0.70	10.00

Note: WDI: World Development Indicator; FSSDA: Finnish Social Science Data Archive; WBGI: World Bank Group Indicator.

variables, the FGLS estimate, and the two-step GMM estimate. We have sufficiently strong evidence to confirm the importance of financial development in enhancing trade activities of environmental goods. The finding implies that higher values of financialization increase *TEG* scale, hence confirming Hypothesis H1. Our results are consistent with the results from previous studies in the trade and environment literature. In particular, the previous papers show the link between financial development and international trade (Beck, 2002; Blackburn and Hung, 1998; Leibovici, 2021) or trade openness (Kim et al., 2010). The literature also considers the role of financialization on environmental issues. For example, Shahbaz et al. (2018) use stock- and bank-based financial development indicators to show that environmental quality is more likely to decrease when financial development is improved. Otherwise, the financial development could lead to a higher level of energy consumption, thus adversely affecting the environmental quality. By using domestic credit to private sectors, Dar and Asif (2018) demonstrate that a financial sector development enhances environmental quality in the long-run, but economic growth and energy use lead to environmental degradation.

Similarly, Ahmed et al. (2020) also emphasize the ecological effects of financial development in the long run. Ahmad et al. (2021) also focus on the relationship between financial development and ecological footprint in emerging countries. They reveal that the development of the financial system adversely influences the ecological quality by increasing the ecological footprint. The beneficial effects of financialization only appear for countries featured a high level of human capital or a well-developed institutional system. These findings can be supported by Shobande and Ogbeifun (2022), who highlight the importance of financial development in reducing carbon emissions and enhancing sustainable development in the Organization for Economic Cooperation and Development (OECD) countries. Overall, these studies and our paper suggest that financial resources should be allocated to environment-friendly businesses rather than wasting them on consumer financing. The findings and suggestions of this paper are critical to paving the way for authorities and policy makers to obtain a better way to develop effective and efficient economic, energy, and environmental policies.

In the following step, we consider the effects of the specific type of financialization, including the development of financial markets (*FINM*) and financial institutions (*FINI*), the estimation results indicate the positive link between *FINM, FINI,* and *TEG*. In general, the results suggest that the coefficients of financialization variables are statistically significant and positive at a 1% significance level, as reported in Table 6. However, we have evidence to believe that the development of financial institutions plays a more vital role in enhancing trade values of environmental goods than the development of the financial market. The coefficients on *FINI* are significantly larger than those on *FINM* in all model estimations. The greater effectiveness of financial institution development than financial market development in improving trade activities is reasonable. Svirydzenka (2016) argued that financial markets imply financial difficulties in issuing bonds and stocks. By contrast, financial institutions are associated with the diversification and quality sorting model in terms of financial constraints like bank loans. The development of financial institutions and financial markets plays a critical role in improving trade activities in their diversification and quality. Still, it is more likely that large-sized firms would find financial markets more familiar as compared to small-sized firms (Walker, 1989). Moreover, the financial markets also significantly influence the managers' behavior (Stein, 1989). Our findings regarding the difference in marginal effects of financial markets and financial

Table 2
Correlation coefficients.

	LnTEG	LFINN	LFINI	LFINM	LFINID	LFINIA	LFINIE	LFINMD	LFINMA	LFINME	ECG	IDL	NAR	HDI	GEI
LnTEG	1														
LFIN	0.719***	1													
LFINI	0.623***	0.902***	1												
LFINM	0.636***	0.908***	0.662***	1											
LFINID	0.549***	0.855***	0.910***	0.664***	1										
LFINIA	0.527***	0.747***	0.869***	0.515***	0.677***	1									
LFINIE	0.391***	0.521***	0.528***	0.442***	0.408***	0.269***	1								
LFINMD	0.596***	0.902***	0.726***	0.910***	0.771***	0.533***	0.439***	1							
LFINMA	0.407***	0.741***	0.531***	0.840***	0.527***	0.471***	0.333***	0.698***	1						
LFINME	0.696***	0.695***	0.449***	0.789***	0.428***	0.306***	0.341***	0.685***	0.449***	1					
ECG	0.554***	0.797***	0.814***	0.627***	0.757***	0.783***	0.255***	0.664***	0.545***	0.416***	1				
IDL	0.0198	−0.101***	−0.255***	0.0298	−0.301***	−0.157***	−0.0336	−0.0125	0.0557	0.109***	−0.0377	1			
NAR	−0.222***	−0.181***	−0.311***	−0.0535	−0.369***	−0.185***	−0.179***	−0.0583*	−0.0162	−0.0132	−0.0601*	0.756***	1		
HDI	0.581***	0.780***	0.825***	0.594***	0.754***	0.823***	0.286***	0.624***	0.525***	0.370***	0.937***	−0.124***	−0.170***	1	
GEI	0.207***	0.384***	0.543***	0.182***	0.562***	0.468***	0.103***	0.260***	0.114***	0.0571	0.489***	−0.516***	−0.532***	0.495***	1

*, **, *** are significant levels at 10%, 5%, and 1%, respectively.

Table 3
Cross sectional dependence tests and stationary tests.

Variable (in level)	CD-test, Pesaran (2004)	Levin-Lin-Chu unit-root test	Im-Pesaran-Shin test (Z-bar)	Variable (in difference)	Levin-Lin-Chu unit-root test	Im-Pesaran-Shin test (Z-bar)
LnTEG	371.27***	−11.30***	−5.22***	D LnTEG	−11.31***	−5.22***
LFIN	145.23***	−6.69***	−3.31***	DLFIN	−17.45***	−23.48***
LFINI	157.26***	−6.92***	−2.12**	DLFINI	−17.06***	−23.09***
LFINM	25.85***	−10.45***	−3.55***	DLFINM	−17.32***	−20.20***
LFINID	153.85***	−9.39***	−0.36	DLFINID	−18.84***	−22.84***
LFINIA	166.5***	−8.28***	7.89	DLFINIA	−7.53***	−12.55***
LFINIE	21.66***	−12.94***	−9.66***	DLFINIE	−25.78***	−25.77***
LFINMD	59.51***	−8.47***	−4.39***	DLFINMD	−21.15***	−24.49***
LFINMA	12.24***	−5.39***	−5.92***	DLFINMA	−16.15***	−24.15***
LFINME	9.81***	−19.64***	−8.87***	DLFINME	−29.42***	−23.52***
ECG	258.34***	−4.35***	10.55	DECG	−17.84***	−14.98***
IDL	40.14***	−5.43***	−1.69**	DIDL	−19.34***	−21.19***
NAR	84.69***	−6.72***	−2.95***	DNAR	−19.25***	−21.20***
HDI	361.358***	−6.02***	3.63	DHDI	−14.57***	−18.78***
GEI	17.71***	−1.15	1.47	DGEI	−17.67***	−21.44***

Note: Regarding the CD test, the null hypothesis is that the cross-section is independent. P-value is closed to zero, implying that data are correlated across panel groups. Regarding the Levin-Lin-Chu unit-root and Im-Pesaran-Shin test, the null hypothesis is "All panels contain unit root" and the alternative hypothesis is "Al least one panel is stationary".
*, **, *** are significant levels at 10%, 5%, and 1%, respectively.

Table 4
Cointegration test.

Model: f (LnTEG and FIN)	Kao test	Pedroni test	Westerlund test
	Dickey-Fuller test	Phillips-Perron t	Variance ratio
FIN	−5.92***	−5.94***	6.16***
FINI	−5.77***	−5.09***	3.46***
FINM	−8.28***	−5.11***	13.53***

Note: Regarding the Kao test, the null hypothesis is "No cointegration", while the alternative hypothesis is "All panels are cointegrated". Regarding the Pedroni test, the null hypothesis is "No cointegration", while the alternative hypothesis is "All panels are cointegrated". Regarding the Westerlund test, the null hypothesis is "No cointegration", while the alternative hypothesis is "Some panels are cointegrated".

institutions on trade activities are aligned with Nguyen and Su (2021). Our study indicates the importance of financial institution development in enhancing trades in environmental goods toward global sustainable development. When the globe raises an ecological protection awareness, governments of countries should know the attendants of *TEG* to satisfy the international environmental standards requirements and demands.

The conclusions regarding environmental effects of financialization and the importance of financial institution development are further checked by adding more explanatory variables and employing various econometric techniques that permit us to control some potential issues, such as heteroskedasticity, fixed effects (FGLS estimate) or endogeneity (two-step GMM estimate), which may lead to biased results. With these techniques, we report the results in Columns 4–12 of Table 5. The results reveal that all conclusions still hold as previously.

We then investigate the effects of depth, access, and efficiency of the financial market (*FINMD, FINMA, FINME*) and financial institution (*FINID, FINIA, FINIE*) on *TEG*. The results are outlined in Tables 6 and .[2] The results and conclusions obtained from PCSE and FGLS estimates are relatively similar, indicating that variables are positive and statistically significant at a 1% significance level. Notably, the impacts of depth and efficiency of *FINI* on *TEG* are more considerable than those of the financial market (*FINM*). In contrast, access to financial institutions (*FINIA*) has a more negligible effect on *TEG* than access to financial markets (*FINMA*). In particular, the coefficients on depth and efficiency of financial institutions are 0.66, 1.87, respectively, compared with 0.21, 0.72 of the financial market. Meanwhile, the coefficients on the access of financial institutions and financial markets are 0.19 and 0.33, respectively. In addition, *FINIE* and *FINME* have the most considerable influence on *TEG* in both estimates. The results indicate that both financial markets and financial institution development appear to increase the trade activities of environmental goods through the positive impacts of financial development in terms of depth and efficiency.

In the following analysis, we conduct a robustness check on our findings by using an alternative measure of trade in environmental goods. Despite the fact that broad-based lists such as the CLEG cover a wide variety of products with environmental applications, they also run the risk of including products that are used for non-environmental purposes. Aiming to maintain a balance between

[2] For space saving, we only report results obtained from PCSE and FGLS. The two-step GMM estimates can be provided by authors upon the request.

Table 5
The effects of financialization on trades in environmental goods: Full sample.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	PCSE estimate			**PCSE estimate with more variables**			**FGLS estimate**			**Two-step GMM**		
	lnTEG	lnTEG	lnTEG	LnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG
L.LFIN	2.72***			2.82***			2.72***			0.79*		
	(0.109)			(0.187)			(0.095)			(0.435)		
L.LFINI		2.01***			2.07***			2.01***			0.70*	
		(0.158)			(0.278)			(0.150)			(0.402)	
L.LFINM			0.26***			0.21***			0.26***			0.02*
			(0.028)			(0.021)			(0.019)			(0.014)
L.ECG	0.23***	0.21***	0.38***	0.24***	0.23***	0.48***	0.23***	0.21***	0.38***	−0.21	−0.13	−0.10
	(0.034)	(0.032)	(0.029)	(0.065)	(0.051)	(0.033)	(0.068)	(0.075)	(0.072)	(0.414)	(0.425)	(0.172)
L.IDL	0.09***	0.10***	0.08***	0.10***	0.09***	0.08***	0.09***	0.10***	0.08***	0.01	0.01	0.02***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.015)	(0.016)	(0.007)
L.NAR	−0.07***	−0.08***	−0.09***	−0.08***	−0.07***	−0.09***	−0.07***	−0.08***	−0.09***	0.03*	0.03**	−0.01
	(0.005)	(0.005)	(0.007)	(0.007)	(0.006)	(0.009)	(0.005)	(0.006)	(0.006)	(0.014)	(0.015)	(0.007)
L.HDI	2.61***	3.86***	4.77***	2.30***	3.79***	4.35***	2.61***	3.86***	4.77***	6.94**	7.66**	1.30
	(0.511)	(0.560)	(0.499)	(0.280)	(0.415)	(0.427)	(0.596)	(0.696)	(0.638)	(2.901)	(3.130)	(1.556)
L.GEI	0.11	−0.01	0.41***	0.30	0.07	0.40**	0.11	−0.01	0.41*	−1.12*	−1.32*	0.83*
	(0.108)	(0.123)	(0.109)	(0.217)	(0.238)	(0.188)	(0.199)	(0.227)	(0.218)	(0.653)	(0.734)	(0.451)
L.INF				−0.05	−0.33	−0.23						
				(0.164)	(0.208)	(0.224)						
L.TAX				0.01***	0.00***	0.01***						
				(0.001)	(0.001)	(0.002)						
Observations	2140	2140	2069	1423	1423	1372	2140	2140	2069	2140	2140	1838
Number of countries	119	119	115	116	116	112	119	119	115	119	119	115

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Table 6
The effects of depth, access, and efficiency of financial market and financial institution on trades in environmental goods.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	PCSE estimate						FGLS estimate					
	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG
L.FINID	0.66***						0.66***					
	(0.027)						(0.044)					
L.FINIA		0.19***						0.19***				
		(0.044)						(0.072)				
L.FINIE			1.87***						1.87***			
			(0.210)						(0.164)			
L.FINMD				0.21***						0.21***		
				(0.027)						(0.020)		
L.FINMA					0.33***						0.33***	
					(0.013)						(0.034)	
L.FINME						0.72***						0.72***
						(0.017)						(0.029)
L.ECG	0.24***	0.48***	0.41***	0.40***	0.56***	0.34***	0.24***	0.48***	0.41***	0.40***	0.56***	0.34***
	(0.023)	(0.021)	(0.026)	(0.030)	(0.029)	(0.041)	(0.073)	(0.075)	(0.073)	(0.074)	(0.080)	(0.116)
L.IDL	0.08***	0.08***	0.08***	0.08***	0.08***	0.07***	0.08***	0.08***	0.08***	0.08***	0.08***	0.07***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.007)
L.NAR	−0.07***	−0.08***	−0.07***	−0.09***	−0.12***	−0.10***	−0.07***	−0.08***	−0.07***	−0.09***	−0.12***	−0.10***
	(0.005)	(0.006)	(0.005)	(0.008)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)
L.HDI	6.26***	8.56***	7.01***	5.53***	2.79***	2.68***	6.26***	8.56***	7.01***	5.53***	2.79***	2.68**
	(0.372)	(0.282)	(0.375)	(0.449)	(0.441)	(0.561)	(0.644)	(0.829)	(0.654)	(0.648)	(0.827)	(1.221)
L.GEI	0.06	0.61***	0.63***	0.41***	−0.35**	−0.39**	0.06	0.61***	0.63***	0.41*	−0.35	−0.39
	(0.133)	(0.114)	(0.121)	(0.122)	(0.111)	(0.129)	(0.227)	(0.235)	(0.226)	(0.212)	(0.221)	(0.186)
Observations	2140	2140	2140	2140	2140	2140	2140	2140	2140	2140	2140	2140
Number of countries	119	119	119	119	119	119	119	119	119	119	119	119

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

comprehensiveness and accuracy, several robustness and sensitivity checks are performed in this paper using alternative, narrower lists of environmental goods in order to complement the main results obtained by the CLEG model (see Table A2 in Appendix). We have selected alternative lists of environmental goods, including the Core CLEG (11 products) and the Core CLEG+ (40 products) with expert advice from Environmental Business International Inc. Based on proprietary data provided by EBI on the size of the global market for various environmental pieces of equipment, the OECD reassessed the likely environmental content of each CLEG's 248 products based on the corresponding HS line. Through this exercise, it was possible to determine which HS codes on the CLEG have a clear environmental content in terms of the value of the trade flows they measure. Approximately two-thirds of all measured trade was accounted for by 11 HS codes (the Core CLEG of 11 products). There are now 40 HS codes where environmental products account for more than a third of all measured trade (the Core CLEG+ of 40 products).

Regarding the APEC List of Environmental Goods, there is a commitment on this list that was endorsed by leaders in 2012 to reduce tariff rates on 54 goods[3] to 5 percent or less, thereby increasing access to environmental technologies and contributing to green growth and trade liberalization. In addition, because the purpose of the APEC list was to obtain more favorable tariff treatment for environmental goods, countries limited themselves to specific goods that could be readily distinguished by customs agents and treated differently for tariff purposes. Solar panels, wind turbines, bamboo flooring, as well as environmental monitoring, analysis, and assessment equipment are included on the list, among others. We select the APEC list in the baseline model since, in the view of trade, a significant contribution to green growth will require a large range of products (APEC, 2021). It encouraged countries to consider adding environmentally friendly or cleaner products to the list. It was the result of negotiated offers in the context of a trade liberalization initiative that the APEC list was formulated - negotiations on which ended before a full consensus was reached (OECD, 2005).

Importantly, the inclusion of two narrower lists of environmental goods in the report is for analytical purposes only. It does not follow from this analysis that trade negotiations ought to consider narrower lists of environmental goods, especially as trade liberalization obeys a different logic. The CLEG products that have been excluded from either the Core CLEG or the Core CLEG + remain entirely appropriate from an environmental perspective since the corresponding HS codes do cover goods having important environmental applications, such as certain pieces of equipment used in separating, crushing or shredding waste and recyclable materials. The same could be said of several water pumps and valves that have applications other than wastewater treatment.

The results in Table 7 reveal that all findings and conclusions reported in Table 5 remain the same. In particular, the results suggest that all *TEG* variables defining *TEG* in different ways are statistically significant at a 1% significance level and largely positive. Furthermore, the marginal effects of financial institution development on trade in environmental goods are also more sizable than those of financial market development.

It is worth noting that these used lists that mostly comprise GEM (Goods for Environmental Management). One may argue that those TEG are technological goods that will, when in use, "reduce environmental risk and minimize pollution and resource use" (OECD, 1999, p.9).[4] They are opposed to EPP (Environmentally Preferable Products), that limit environmental damage, when used or produced. The use of GEM makes it likely that the link identified in the paper stems more from the fact that those goods are technological rather than from the environmentally friendly nature. Hence, it is likely that the categories of TEG selected may drive the results. To justify our results, we also expand the discussion to a list of EPP as suggested by Zugravu-Soilita (2018). The results of this analysis are reported in Columns 10–11 in Table 7. The results indicate that the nexus between financialization and TEG remains consistent, as in Columns 1–9.

Another concern is that variation of exports could be driven by factors not captured by the model, such as characteristics of destination countries. To check this point, we develop a gravity model that includes country characteristics for both importers and exporters. The information about this model as well as the results, are summarized in Table A3 in Appendix. The results suggest that the concern is not an issue of our model.

4.2. Further discussion: subsamples of developing and developed economies

In the further analysis, we examine the impact of financialization on *TEG* for sub-samples, including 85 developing and 34 developed countries. We display trade values of green goods in developing and developed countries in Figure A.1 in Appendix. Except for APEC list, the developed countries have a high trade value of green goods as compared to those of developing countries. The reasons for this analysis are as follows. There are substantial distinctions in the financial system in developed and developing countries (Do and Levchenko, 2004). Theoretically and empirically, countries with a well-developed financial sector have comparative advantages thus, they become more competitive in the foreign markets. Beck (2002) states that countries with better financial systems have a higher trade balance in manufactured goods. This paper believes that similar evidence can be found with environmental goods. The financially dependent sectors grow considerably, especially in wealthy countries (Do and Levchenko, 2004). Environmental goods can be considered a highly financially dependent sector (Ha et al., 2021a,b; Le and Hoang, 2021). Ha et al. (2021a,b) even provide "a box-ticking exercise" evidence in the case of developing countries, in which firms in developing economies often obtain the environmental standard certification without complying with environmental requirements. In this manner, the same environmental good sector is less financially dependent in developing countries than in developed countries. Therefore, financialization in promoting trade values of environmental goods becomes less critical in developing countries. Moreover, we also believe that the trade activities of environmental goods in the global market cannot develop in the countries with "a box-ticking exercise" evidence since the "*fake*"

[3] HS 2007 code of the CLEG list is provided in Table A.2 in Appendix.

[4] We greatly appreciate the anonymous Reviewer for pointing out this issue.

Table 7
Financialization and trade in environmental goods: Alternative measures.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	CoreCLEGPLUS TEG			PEGS TEG			PEGS TEG			EPP		
L.FIN	0.29***			0.71***			0.56***			0.77***		
	(0.028)			(0.050)			(0.048)			(0.054)		
L.FINI		0.22***			0.49***			0.44***			0.53***	
		(0.031)			(0.051)			(0.056)			(0.055)	
L.FINM			0.02***			0.07***			0.05***			0.07***
			(0.003)			(0.008)			(0.006)			(0.009)
L.ECG	0.09***	0.14***	0.15***	0.14***	0.26***	0.29***	0.14***	0.22***	0.25***	0.17***	0.30***	0.33***
	(0.006)	(0.010)	(0.011)	(0.011)	(0.017)	(0.018)	(0.010)	(0.016)	(0.016)	(0.011)	(0.018)	(0.018)
L.IDL	0.00***	0.00***	0.00***	0.01***	0.02***	0.01***	0.01***	0.01***	0.01***	0.01***	0.02***	0.01***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
L.NAR	−0.01***	−0.01***	−0.01***	−0.02***	−0.02***	−0.02***	−0.02***	−0.02***	−0.02***	−0.02***	−0.02***	−0.02***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
L.HDI	−0.97***	−0.85***	−0.60***	−1.94***	−1.55***	−1.08***	−1.79***	−1.57***	−1.08***	−2.19***	−1.78***	−1.25***
	(0.111)	(0.118)	(0.077)	(0.187)	(0.193)	(0.134)	(0.186)	(0.200)	(0.126)	(0.200)	(0.206)	(0.143)
L.GEI	−0.08***	−0.10***	−0.04**	−0.02	−0.04	0.10**	−0.07**	−0.10***	0.02	−0.02	−0.05	0.10**
	(0.016)	(0.016)	(0.017)	(0.036)	(0.035)	(0.045)	(0.027)	(0.023)	(0.033)	(0.036)	(0.035)	(0.047)
Observations	2140	2140	2069	2140	2140	2069	2140	2140	2069	2140	2140	2069
Number of countries	119	119	115	119	119	115	119	119	115	119	119	115

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

environmental goods cannot "*cheat*" the customers with high demands and requirements for environmental criteria.

The estimation results are reported in Table 8, which shows that financial development (*FIN*), financial institutions development (*FINI*), financial markets development (*FINM*) variables are statistically significant at a 1% significance level and positive. It is more likely that the effects of financialization on *TEG* are more sizable for a subsample of developed countries. Particularly, the coefficients of *FIN*, *FINI*, *FINM* on *TEG* are respectively 2.91, 2.17, and 0.27 in the subsample of developed countries as compared to 2.55, 0.8, 0.57 in the subsample of developed countries. The following reasons help us to understand the more sizable influences of digitalization on TEG in developed countries. It is also worth noticing that financial institution development (*FINI*) has a more considerable impact on *TEG* than those effects of financial market development (*FINM*) in both subsamples. This finding in developing and developed economies provide more evidence to support our previous conclusions on the importance of financial institution development. These findings are rechecked again using econometric techniques, including FGLS and two-step GMM. We report the results of these checks in Table 9. There is evidence to believe that our findings are robust and reliable.

In the subsequent analysis, we empirically analyze the association between the short-term and long-term effects of financialization on trade activities of environmental goods by applying the DFE-ARDL model. The results are shown in Table 10. Regarding financialization, as reported in Panel A, its short-term effects on *TEG* are barely significant, as only financial development (*FIN*) and financial institutions (*FINI*) are negative and significant at a 5% level of significance. On the other hand, in the long-term, financialization has statistically significant and positive contributions to the rise in *TEG*, which is compatible with the results reported in Table 5. In Panel B, in the short-term, financialization does not have an impact on *TEG* in developed countries but barely affects TEG in developing countries. Meanwhile, financialization has a pronounced effect in these countries in the long term. This finding means that the expansion of financialization leads to the increase of *TEG,* and these effects become more evident in the long run.

4.3. Further discussion: moderating role of uncertainty

Further analysis examines whether financial development deteriorates the adverse effects of uncertainty on trade size in environmental goods (TEG). To explore our prediction, we use the World Uncertainty Index, which counts the frequency of appearance of the word "uncertainty" (*Unc_Word)* or the number of pages having the word "uncertainty" (*Unc_Page)*. The uncertainty data is sourced from the Economist Intelligence Unit (EIU). The results are reported in Table 10. We replicate our previous estimation but add a term that is an interaction between financialization and global uncertainty variables. Table 11 demonstrates that the interactions between financialization and uncertainty variables are statistically significant at 1% and largely positive. The results imply that the size of the trade values of environmental goods tends to decline in the uncertain world. However, the existence of a sound financial system is more likely to mitigate the consequences or uncertainty. This statistical exercise plays a role in highlighting the importance.

5. Conclusions

By applying diverse econometric techniques to a global sample of 85 developing and 34 developed countries during the 2001–2019

Table 8
Financialization and trade in environmental goods: Subsamples of developing and developed economies.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Developed countries			**Developing countries**		
	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG
L.FIN	2.91***			2.55***		
	(0.114)			(0.186)		
L.FINI		2.17***			0.80***	
		(0.161)			(0.168)	
L.FINM			0.27***			0.57***
			(0.032)			(0.044)
L.ECG	−0.31***	0.04	0.34***	−0.02	0.48***	0.28***
	(0.043)	(0.044)	(0.044)	(0.044)	(0.030)	(0.030)
L.IDL	0.10***	0.10***	0.09***	0.20***	0.17***	0.15***
	(0.005)	(0.005)	(0.006)	(0.011)	(0.010)	(0.007)
L.NAR	−0.07***	−0.08***	−0.10***	0.05*	0.07***	0.06**
	(0.005)	(0.005)	(0.008)	(0.025)	(0.026)	(0.025)
L.HDI	0.21	2.70***	2.58***	−6.89***	−1.55	−7.90***
	(0.578)	(0.623)	(0.696)	(1.208)	(1.203)	(1.544)
L.GEI	−0.62***	−1.00***	−0.71***	2.58***	4.00***	3.45***
	(0.156)	(0.182)	(0.153)	(0.310)	(0.373)	(0.357)
Observations	612	612	612	1528	1528	1457
Number of countries	34	34	34	85	85	81

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Table 9
Robustness checks on effects of financialization and trade in environmental goods: Subsamples of developing and developed economies.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FGLS estimate						**Two-step GMM**					
	Developed countries			Developing countries			Developed countries			Developing countries		
	lnTEG	lnTEG	lnTEG	LnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG	lnTEG
L.FIN	2.91***			2.55***			0.84			0.73*		
	(0.103)			(0.228)			(0.498)			(0.444)		
L.FINI		2.17***			0.80***			1.13**			0.88**	
		(0.169)			(0.304)			(0.509)			(0.448)	
L.FINM			0.27***			0.57***			0.20*			0.03*
			(0.020)			(0.057)			(0.119)			(0.017)
L.ECG	−0.31***	0.04	0.34***	−0.02	0.48***	0.28***	0.07	0.29	−0.12	−0.23	−0.18	−0.25
	(0.091)	(0.106)	(0.102)	(0.104)	(0.103)	(0.095)	(0.307)	(0.720)	(0.294)	(0.279)	(0.282)	(0.252)
L.IDL	0.10***	0.10***	0.09***	0.20***	0.17***	0.15***	−0.01	−0.03	0.05	0.03***	0.02	0.03***
	(0.005)	(0.006)	(0.006)	(0.012)	(0.013)	(0.012)	(0.023)	(0.039)	(0.036)	(0.009)	(0.015)	(0.009)
L.NAR	−0.07***	−0.08***	−0.10***	0.05	0.07	0.06	−0.02	0.00	0.05	−0.02	−0.01	−0.02**
	(0.006)	(0.006)	(0.006)	(0.042)	(0.046)	(0.043)	(0.073)	(0.084)	(0.045)	(0.011)	(0.013)	(0.008)
L.HDI	0.21	2.70***	2.58***	−6.89***	−1.55	−7.90***	−1.29	−1.88	7.41	−2.12	−0.46	0.39
	(0.742)	(0.875)	(0.821)	(2.070)	(2.223)	(2.162)	(2.069)	(7.923)	(5.216)	(1.758)	(2.462)	(2.444)
L.GEI	−0.62***	−1.00***	−0.71***	2.58***	4.00***	3.45***	−0.07	−0.83	−0.55	0.52	−0.38	0.96
	(0.222)	(0.262)	(0.253)	(0.511)	(0.551)	(0.502)	(0.478)	(1.516)	(0.769)	(0.495)	(0.535)	(0.733)
Observations	612	612	612	1528	1528	1457	577	611	577	1359	1359	1295
Number of countries	34	34	34	85	85	81	34	34	34	85	85	81

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Table 10
Financialization and trades in environmental goods: Short-run and long-run effects Panel A: Total sample.

VARIABLES	(1)	(2)	(3)
	Whole sample		
	FIN	FI	FM
	Short-term effect		
EC term	−0.42***	−0.43***	−0.32***
	(0.017)	(0.018)	(0.015)
D. FIN	−0.32**	−0.28**	−0.02
	(0.136)	(0.134)	(0.015)
	Long-term effect		
FIN	2.00***	2.00***	0.02
	(0.190)	(0.178)	(0.035)
Observations	2142	2142	2142

Panel B: Developing and developed economies separately

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Developing economies			**Developed economies**		
	FIN	FI	FM	FIN	FI	FM
	Short-term effect					
Error correction term	−0.45***	−0.46***	−0.35***	−0.22***	−0.23***	−0.17***
	(0.021)	(0.021)	(0.019)	(0.023)	(0.024)	(0.018)
D. FIN	−0.36**	−0.29*	−0.02	0.23	0.27	−0.01
	Long-term effect					
	(0.169)	(0.162)	(0.017)	(0.163)	(0.203)	(0.049)
FIN	1.97***	1.94***	0.02	1.72***	1.91***	−0.13
	(0.229)	(0.213)	(0.037)	(0.379)	(0.359)	(0.223)
Observations	1530	1530	1458	612	612	612

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.
Note: The DFE-ARDL is employed.

Table 11
The moderating roles of uncertainty.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	UNC_Word			UNC_Page		
	FIN	FI	FM	FIN	FI	FM
L.FIN	1.10***	0.93**	−0.18**	0.65**	0.12	−0.53***
	(0.300)	(0.403)	(0.088)	(0.321)	(0.408)	(0.120)
L.UNC	5.52***	6.02***	5.66***	7.31***	8.49***	8.10***
	(0.766)	(0.908)	(0.845)	(1.056)	(1.288)	(1.100)
L.FIN*UNC	1.49***	1.43***	0.53***	2.04***	2.51***	1.05***
	(0.398)	(0.529)	(0.134)	(0.428)	(0.576)	(0.185)
L.ECG	0.18***	0.56***	0.85***	0.20***	0.55***	0.82***
	(0.041)	(0.044)	(0.041)	(0.042)	(0.044)	(0.040)
L.IDL	0.07***	0.07***	0.05***	0.06***	0.06***	0.05***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
L.NAR	−0.07***	−0.07***	−0.09***	−0.07***	−0.07***	−0.08***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)
L.HDI	1.23**	0.67	1.49***	1.16**	0.59	1.69***
	(0.565)	(0.718)	(0.577)	(0.500)	(0.631)	(0.540)
L.GEI	0.02	−0.32**	−0.12	−0.07	−0.41**	−0.25*
	(0.133)	(0.156)	(0.136)	(0.139)	(0.163)	(0.142)
Observations	1943	1943	1907	1943	1943	1907
Number of countries	108	108	106	108	108	106

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

period, the paper examines the influences of the financial institution and market development and their evaluation in terms of depth, access and efficiency on the trade in environmental goods. We find that both financial market and institution development boost the trade in environmental goods through the positive impacts of financial development in terms of depth, access, and efficiency. Among two indexes of financialization, we have evidence to believe that the development of financial institutions plays a more critical role in promoting the trade in environmental goods. Furthermore, the effect of financialization on trade in environmental goods is more evident in the long term and in developed countries. Finally, if these economies have a well-developed financial system, the effects of uncertainty or risk on trade in environmental goods value are reduced.

Research has shown that the trade activities and values of environmental goods are highly associated with the development of financialization on the policy front. The stability and development of the financial sector play a critical role in enhancing a country's comparative advantage to compete and survive better in the foreign market where the customers prefer friendly-environmental products. To pursue this goal, governments of countries should propose policies to promote the development and stability of the financial system to raise their competitive advantages and success in the markets of environmental goods. Our findings also suggest that the trade activities and values of environmental goods are prerequisites if there is either local or global uncertainty and risk. Under this circumstance, the governments of these countries should propose financial support policies or policies to help countries and environmental-goods-trading actors mitigate financial pressure, such as a reduction in tax, an extension of a tax payment period, or a decrease in interest rate. However, we also want to emphasize that this positive influence will result in the long term rather than the short term. Therefore, we recommend investing in developing financial institutions and markets to facilitate the growth of environmental goods scale. These policies should be implemented consistently and for a sufficiently long period. For low-income & lower-middle-income countries, boosting access to financial services (financial inclusion) should be prioritized. In contrast, upper-middle-income and high-income countries should target financial inclusion and promote the size and liquidity of financial institutions. Lastly, our findings reveal that the effects of financialization on TEE become more pronounced in the economies that have a well-developed financial system. The results suggest that the government should devote resources to the development of institutional system, which may prevents a box-ticking exercise" evidence. A strong institutional system can help countries stimulate the trade activities of environmental goods in the global market to produce the "*real*" environmental goods.

The research presented here has some limitations. The first limitation may come from the empirical estimation approaches, including PCSE and FGLS. As a result of contemporaneous correlations across units and unit-level heteroskedasticity, time-series cross-section data often present non-spherical errors. To improve inference and estimation, it is necessary to use the non-spherical error structure to fit linear models to these data. A feasible generalized least squares (FGLS) estimator suggested by Parks (1967) and made popular by Kmenta (1986), and the panel-corrected standard errors (PCSE) developed by Beck and Katz (1995) are recommended to use if there is any cross-sectional dependence. As a result, we examined whether there were cross-sectional effects before applying these models. In the presence of panel error structures, PCSE and FGLS provide accurate estimation of variability while controlling both autocorrelation and heteroskedasticity (Beck and Katz, 1995). Ignoring cross-sectional dependence of errors may lead to severe consequences, and the existence of some form of cross-sectional correlation of errors in panel data applications in economics is likely to be the rule rather than the exception (Chudik & Pesaran, 2013). The extent of cross-sectional dependence and the sources creating the cross-sectional dependence cause the issues of misleading inference and inconsistent estimators stemming from the conventional panel estimators such as fixed or random effects to be more serious. The drawback of these methods is that they do not take into account cross-sectional independence and slope homogeneity, which may result in misleading estimates. The different approaches that take these issues into account should be employed in the robustness checks. A further limitation of this article is that it does not examine the channels through which financialization influences trade values of environmental goods, such as institutional quality and level of knowledge performance. The income level of a country may also encompass these channels, but it is essential to consider the effects of these specific channels on the nexus of financialization and trade values of environmental goods. Further research should be conducted to address these issues.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Compliance with ethical standards

- Disclosure of potential conflicts of interest
- Research involving Human Participants and/or Animals
- Informed consent

Contributions

Le Thanh Ha was equally contributed to all stages of preparing, drafting, writing and revising this review article. All authors listed have made a substantial, direct, and intellectual contribution to the work during different preparation stages. All authors read, revised

and approved the final version of this manuscript.

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Le Thanh Ha and Bui Thi Minh Anh do not have any conflict with others and organizations.

Declaration of competing interest

He 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

Data will be made available on request.

Appendix A

Table A.1
Countries in the sample

High Income		
Australia	Austria	Canada
Chile	Croatia	Czech Republic
Denmark	Estonia	Finland
Greece	Hungary	Iceland
Ireland	Israel	Italy
Japan	Korea, Rep.	Latvia
Lithuania	Luxembourg	Malta
Namibia	Netherlands	New Zealand
Norway	Oman	Panama
Poland	Portugal	Saudi Arabia
Seychelles	Singapore	Slovak Republic
Slovenia	Spain	Sweden
Switzerland	Trinidad and Tobago	United Arab Emirates
United Kingdom	United States	Uruguay
Upper Middle Income		
Albania	Algeria	Argentina
Azerbaijan	Belgium	Bosnia and Herzegovina
Botswana	Brazil	Bulgaria
China	Colombia	Costa Rica
Dominican Republic	Ecuador	Fiji
Gabon	Georgia	Guatemala
Iran, Islamic Rep.	Jamaica	Jordan
Kazakhstan	Mauritius	Mexico
North Macedonia	Paraguay	Peru
Romania	Russian Federation	South Africa
Sri Lanka	Thailand	Turkey
Low Income and Lower-Middle-Income		
Angola	Bangladesh	Bolivia
Burundi	Cambodia	Cameroon
Cape Verde	Chad	Congo, Dem. Rep.
Cote d'Ivoire	Egypt, Arab Rep.	El Salvador
Gambia	Ghana	Haiti
Honduras	India	Indonesia
Kenya	Kyrgyz Republic	Lao PDR
Lesotho	Liberia	Madagascar
Malawi	Mali	Mauritania
Mongolia	Morocco	Mozambique
Myanmar	Nepal	Nicaragua
Niger	Papua New Guinea	Philippines
Rwanda	Sao Tome and Principe	Senegal
Sierra Leone	Swaziland	Tajikistan

(*continued on next page*)

Table A.1 (*continued*)

Tanzania	Togo	Tunisia
Uganda	Ukraine	Uzbekistan
Zambia		

Table A.2
Lists of Environmental Goods

CLEG List	560314; 560721; 560790; 560811; 560890; 630510; 680610; 680690; 680800; 681011; 681019; 681091; 691010; 700800; 700991; 700992; 701931; 701939; 730210; 730230; 730240; 730290; 730300; 730431; 730490; 730630; 730690; 730820; 730890; 730900; 731010; 731029; 732111; 732119; 732189; 732190; 732490; 732510; 732690; 761090; 761100; 761290; 830630; 840219; 840290; 840410; 840420; 840490; 840510; 840681; 840682; 840690; 380210; 390940; 392010; 392030; 392111; 392113; 392510; 400259; 441872; 450410; 450490; 530310; 530500; 540500; 848110; 848130; 848140; 848180; 848190; 848340; 848360; 850161; 850162; 850163; 850164; 850220; 850231; 850239; 850300; 850421; 850422; 850423; 850431; 850432; 850433; 850434; 850440; 850490; 850590; 850680; 850720; 850980; 851410; 851420; 851430; 851490; 851629; 853010; 853080; 853090; 853710; 853720; 853921; 853931; 853932; 854140; 854370; 854390; 860110; 860120; 860210; 860290; 860310; 860390; 860400; 860500; 840991; 840999; 841011; 841012; 841013; 841090; 841181; 841182; 841199; 841280; 841290; 841320; 841350; 841360; 841370; 841381; 841410; 841430; 841440; 841459; 841480; 841490; 841581; 841780; 841790; 841861; 841869; 841919; 841939; 841940; 841950; 841960; 841989; 841990; 842119; 842121; 842129; 842139; 842191; 842199; 842220; 842290; 842833; 842940; 846291; 846596; 846599; 846694; 847420; 847982; 847989; 847990; 860610; 860630; 860691; 860692; 860699; 860711; 860712; 860719; 860721; 860729; 860730; 860791; 860799; 860800; 870290; 870390; 871200; 871411; 871419; 871420; 871491; 871492; 871493; 871494; 871495; 871496; 871499; 871639; 890790; 900190; 900290; 900580; 901380; 901390; 901530; 901540; 901580; 901590; 902511; 902519; 902610; 902620; 902680; 902690; 902710; 902720; 902730; 902750; 902780; 902790; 902810; 902820; 902830; 902890; 903010; 903020; 903031; 903032; 903033; 903039; 903084; 903089; 903090; 903110; 903120; 903149; 903180; 903190; 903210; 903220; 903281; 903289; 903290; 903300; 940510; 940520; 940540; 950720
Core CLEG	841780; 841790; 842121; 842129; 842139; 842199; 902710; 902720; 902730; 902750; 902780
Core CLEG+	380210; 730300; 730431; 730490; 730630; 730690; 730900; 731010; 731029; 732490; 761290; 840410; 840420; 840510; 841410; 841780; 841790; 841989; 842121; 842129; 842139; 842199; 842833; 846291; 847982; 848110; 848130; 848140; 850590; 901540; 901580; 902610; 902680; 902710; 902720; 902730; 902750; 902780; 902810; 902820
PEGS	560314; 680610; 680690; 680800; 681011; 681019; 681091; 700800; 700991; 700992; 701931; 701939; 730210; 730230; 730240; 730290; 730820; 730890; 732111; 732119; 732189; 732190; 761090; 761100; 830630; 840510; 840681; 840682; 840690; 380210; 390940; 392010; 392030; 392111; 392113; 392510; 400259; 450410; 450490; 540500; 848340; 848360; 850161; 850162; 850163; 850164; 850220; 850231; 850239; 850300; 850421; 850422; 850423; 850431; 850432; 850433; 850434; 850440; 850680; 850720; 853010; 853080; 853090; 853710; 853720; 853921; 853931; 853932; 854140; 860110; 860120; 860210; 860290; 860310; 860390; 860400; 860500; 840991; 840999; 841011; 841012; 841013; 841090; 841181; 841182; 841280; 841290; 841381; 841581; 841861; 841869; 841919; 841950; 841989; 841990; 842139; 847989; 860610; 860630; 860691; 860692; 860699; 860711; 860712; 860719; 860721; 860729; 860730; 860791; 860799; 860800; 870290; 870390; 871200; 871411; 871419; 871420; 871491; 871492; 871493; 871494; 871495; 871496; 871499; 871639; 900190; 900290; 900580; 901530; 901590; 902511; 902519; 902610; 902620; 902680; 902690; 902710; 902720; 902730; 902750; 902780; 902790; 902830; 903010; 903020; 903031; 903032; 903033; 903039; 903084; 903089; 903090; 903120; 903149; 903180; 903190; 903210; 903220; 903281; 903289; 903290; 903300; 940510; 940520; 940540
APEC List	441872; 840290; 840410; 840490; 840690; 841182; 841290; 841780; 841790; 841919; 841939; 841960; 841989; 841990; 842121; 842129; 842139; 842199; 847420; 847982; 847989; 847990; 850164; 850231; 850300; 851410; 851420; 851430; 851490; 854140; 854390; 902610; 902620; 902680; 902690; 902710; 902720; 902730; 902750; 902780; 902790; 903180; 903190; 903289; 903290; 903300
EGG List	050900, 121110, 121120, 121190, 130110, 130120, 130190, 130219, 140190, 140310, 140390, 140410, 150510, 150590, 152110, 152190, 230690, 230890, 310100, 320190, 320300, *320910*, 321000, 400110, 400121, 400122, 400129, 400280, 450110, 450200, 450310, 450390, *460120*, 460191, 460210, 480610, 500200, 500400, 500600, 500710, 500720, 500790, 510111, 510119, 510121, 510129, 510130, 510310, 510320, 510400, 510510, 510521, 510529, 510610, 510710, 510910, 510910, 511111, 511119, 511190, 511211, 511219, 511290, 511290, 530110, 530121, 530129, 530210, 530290, 530310, 530410, 530521, 530591, 530710, 530720, 530810, 530890, 531010, 531090, 531100, 531100, 560710, 560721, 560729, 560750, 560890, 570110, 570220, 570231, 570241, 570251, 570291, 570310, 580110, 581099, 600129, 600199, 600241, 600291, 630120, 630510, 670100, 680800, 850680, 850780, *960310*

Table A.3
A robustness check by using a gravity model

Panel A:		
GDP_j	Log value of GDP in country *j* (host country) in year t.	CEPII (The World Bank database)
Contig	The dummy taking a value of 1 if there is a contiguity between two countries.	CEPII
comlang_off	The dummy taking a value of 1 if they have the same official language.	CEPII
colony	The dummy taking a value of 1 if they have the colonial relationship.	CEPII
comcol	The dummy taking a value of 1 if a country is a common colonizer post 1945.	CEPII
smctry	The dummy taking a value of 1 if a country is the same currently or in the past.	CEPII
D	Log value of the distance between country *i* and *j*, and 0 otherwise.	CEPII

Panel B:			
VARIABLES	(1)	(2)	(3)
	lnTEG	lnTEG	lnTEG
LFIN	0.77***		
	−0.054		
LFINI		0.53***	
		−0.055	
LFINM			0.07***
			−0.009
LnGDP_d	0.373***	0.211***	0.119***
	(0.140)	(0.100)	(0.007)
LnGDP_o	0.581***	0.339***	0.681***
	(0.115)	(0.108)	(0.117)
D	−0.625***	−0.323***	−0.427***
	(0.0605)	(0.0411)	(0.0613)
comlang_off	0.387***	0.227***	0.611***
	(0.147)	(0.102)	(0.213)
Comcol	0.340	0.340	0.340
	(0.325)	(0.325)	(0.325)
Comrelig	0.361	0.361	0.361
	(0.238)	(0.238)	(0.238)
Rta	0.194*	0.188*	0.199*
	(0.114)	(0.115)	(0.112)
Observations	34,506	34,506	34,506
Number of pair	4502	4502	4502

Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.

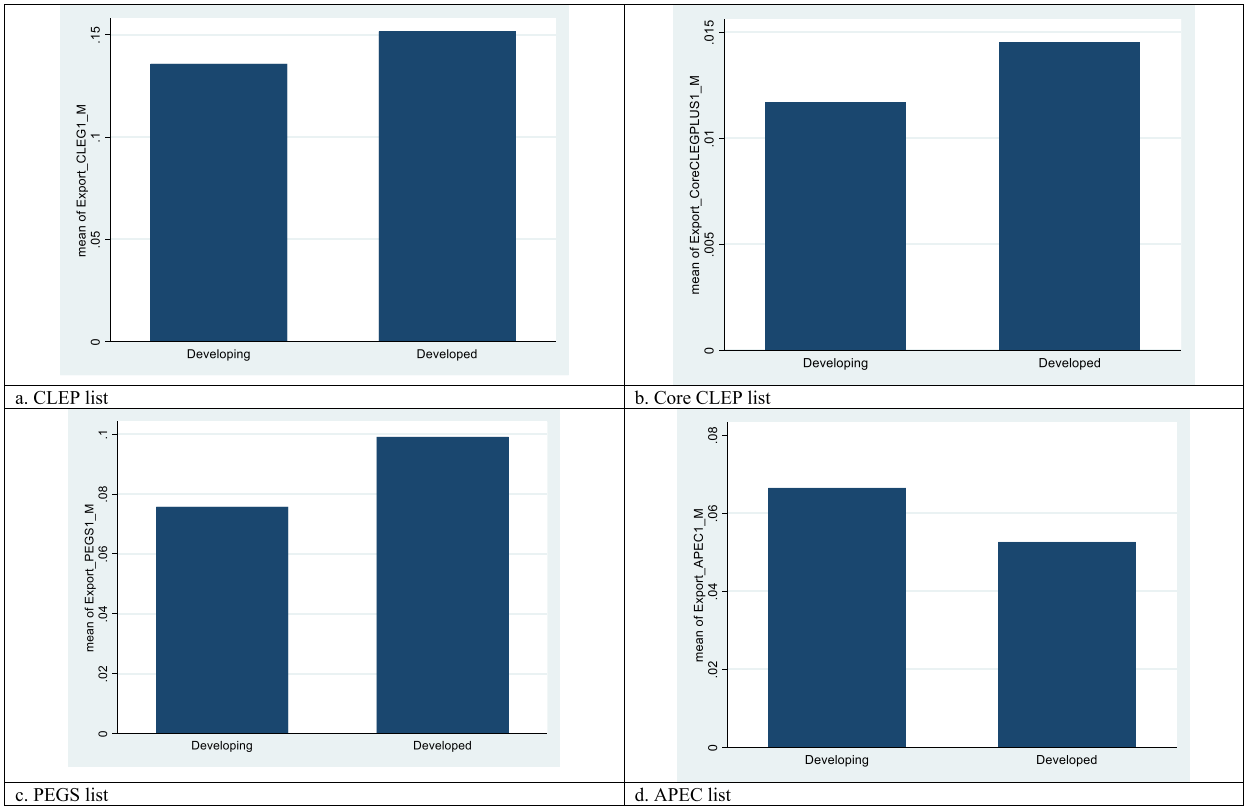

Fig. A.1. Trade values of green goods in developing and developed countries

References

Acharyya, R., Jones, R.W., 2001. Export quality and income distribution in a small dependent economy. Int. Rev. Econ. Finance 10 (4), 337–351. https://doi.org/10.1016/S1059-0560(01)00082-X.

Adams, S., Klobodu, E.K.M., 2018. Financial development and environmental degradation: does political regime matter? J. Clean. Prod. 197, 1472–1479. https://doi.org/10.1016/j.jclepro.2018.06.252.

Ahmad, M., Ahmed, Z., Yang, X., Hussain, N., Sinha, A., 2021. Financial development and environmental degradation: do human capital and institutional quality make a difference? Gondwana Res. https://doi.org/10.1016/j.gr.2021.09.012.

Ahmed, F., Kousar, S., Pervaiz, A., Ramos-Requena, J.P., 2020. Financial development, institutional quality, and environmental degradation nexus: new evidence from asymmetric ARDL Co-integration approach. Sustainability 12 (18), 7812. https://doi.org/10.3390/su12187812.

Al Mamun, M., Sohag, K., Shahbaz, M., Hammoudeh, S., 2018. Financial markets, innovations and cleaner energy production in OECD countries. Energy Econ. 72, 236–254. https://doi.org/10.1016/j.eneco.2018.04.011.

Ali, Q., Khan, M.T.I., Khan, M.N.I., 2018. Dynamics between financial development, tourism, sanitation, renewable energy, trade and total reserves in 19 Asia cooperation dialogue members. J. Clean. Prod. 179, 114–131. https://doi.org/10.1016/j.jclepro.2018.01.066.

Aslam, A., Novta, N., Rodrigues-Bastos, F., Celasun, O., 2017. Calculating trade in value added. IMF Working Papers 2017 (178). https://doi.org/10.5089/9781484311493.001.A001.

Beck, N., Katz, J.N., 1995. What to do (and not to do) with Time-Series Cross-Section Data. Am. Polit. Sci. Rev. 89 (3), 634–647. https://doi.org/10.2307/2082979.

Beck, T., 2002. Financial development and international trade: is there a link? J. Int. Econ. 57 (1), 107–131. https://doi.org/10.1016/S0022-1996(01)00131-3.

Bernini, M., Guillou, S., Bellone, F., 2015. Financial leverage and export quality: evidence from France. J. Bank. Finance 59, 280–296. https://doi.org/10.1016/j.jbankfin.2015.06.014.

Bhattacharyya, S., Hodler, R., 2014. Do natural resource revenues hinder financial development? The role of political institutions. World Dev. 57, 101–113. https://doi.org/10.1016/j.worlddev.2013.12.003.

Blackburn, K., Hung, V.T.Y., 1998. A theory of growth, financial development and trade. Economica 65 (257), 107–124.

Brooks, E., 2003. Why Don't Firms Export More? Product Quality and Colombian Plants. https://escholarship.org/uc/item/8hc9m1wg.

Canh, N.P., Thanh, S.D., Nasir, M.A., 2020. Nexus between financial development & energy intensity: two sides of a coin? J. Environ. Manag. 270, 110902 https://doi.org/10.1016/j.jenvman.2020.110902.

Cantore, N., Cheng, C.F.C., 2018a. International trade of environmental goods in gravity models. J. Environ. Manag. 223, 1047–1060. https://doi.org/10.1016/j.jenvman.2018.05.036.

Cantore, N., Cheng, C.F.C., 2018b. International trade of environmental goods in gravity models. J. Environ. Manag. 223, 1047–1060. https://doi.org/10.1016/j.jenvman.2018.05.036.

Capasso, S., Jappelli, T., 2013. Financial development and the underground economy. J. Dev. Econ. 101, 167–178. https://doi.org/10.1016/j.jdeveco.2012.10.005.

Cavalcante, R.T., Sobreiro, V.A., Kimura, H., 2018. Determinants of the non-life insurance market in Brazil. Review of Development Finance 8 (2), 89–95. https://doi.org/10.1016/j.rdf.2018.11.004.

Chen, Z., Huang, W., Zheng, X., 2019. The decline in energy intensity: does financial development matter? Energy Pol. 134, 110945 https://doi.org/10.1016/j.enpol.2019.110945.

Chiang, S.-C., Masson, R.T., 1988. Domestic industrial structure and export quality. Int. Econ. Rev. 29 (2), 261–270. https://doi.org/10.2307/2526665.
Claver, E., Lopez, M.D., Molina, J.F., Tari, J.J., 2007. Environmental management and firm performance: a case study. J. Environ. Manag. 84 (4), 606–619.
Costantini, V., Mazzanti, M., 2012. On the green and innovative side of trade competitiveness? The impact of environmental policies and innovation on EU exports. Res. Pol. 41 (1), 132–153.
Crinò, R., Epifani, P., 2012. Productivity, quality and export behaviour. Econ. J. 122 (565), 1206–1243. https://doi.org/10.1111/j.1468-0297.2012.02529.x.
Dar, J.A., Asif, M., 2018. Does financial development improve environmental quality in Turkey? An application of endogenous structural breaks based cointegration approach. Manag. Environ. Qual. Int. J. 29 (2), 368–384. https://doi.org/10.1108/MEQ-02-2017-0021.
de Melo, J., Solleder, J.-M., 2020. Barriers to trade in environmental goods: how important they are and what should developing countries expect from their removal. World Dev. 130, 104910 https://doi.org/10.1016/j.worlddev.2020.104910.
Do, Q.-T., Levchenko, A.A., 2004. Trade and Financial Development. World Bank. https://doi.org/10.1596/1813-9450-3347.
Doan, T.N., Ha, L.T., 2022. Is religiosity distance a driver of trade in environmental goods? Appl. Econ. Lett. 1–5. https://doi.org/10.1080/13504851.2022.2083058, 0(0).
Donnenfeld, S., Mayer, W., 1987. The quality of export products and optimal trade policy. Int. Econ. Rev. 28 (1), 159–174. https://doi.org/10.2307/2526865.
Fan, H., Lai, E.L.-C., Li, Y.A., 2015. Credit constraints, quality, and export prices: theory and evidence from China. J. Comp. Econ. 43 (2), 390–416. https://doi.org/10.1016/j.jce.2015.02.007.
Fu, Q., Chen, Y.E., Jang, C.-L., Chang, C.-P., 2020. The impact of international sanctions on environmental performance. Sci. Total Environ. 745, 141007 https://doi.org/10.1016/j.scitotenv.2020.141007.
Gala, P., Camargo, J., Magacho, G., Rocha, I., 2018. Sophisticated jobs matter for economic complexity: an empirical analysis based on input-output matrices and employment data. Struct. Change Econ. Dynam. 45, 1–8. https://doi.org/10.1016/j.strueco.2017.11.005.
García-Alonso, M. del C., Levine, P., Morga, A., 2004. Export credit guarantees, moral hazard and exports quality. Bull. Econ. Res. 56 (4), 311–327. https://doi.org/10.1111/j.1467-8586.2004.00206.x.
Ha, L.T., 2022a. Effects of digitalization on financialization: empirical evidence from European countries. Technol. Soc. 68, 101851 https://doi.org/10.1016/j.techsoc.2021.101851.
Ha, L.T., 2022b. Are Digital Business and Digital Public Services a Driver for Better Energy Security? Evidence from a European Sample. Environmental Science and Pollution Research. https://doi.org/10.1007/s11356-021-17843-2.
Ha, L.T., Dung, H.P., Thanh, T.T., 2021a. Economic complexity and shadow economy: a multi-dimensional analysis. Econ. Anal. Pol. 72, 408–422. https://doi.org/10.1016/j.eap.2021.09.011.
Ha, L.T., Nam, P.X., Thanh, T.T., 2021b. Effects of bribery on firms' environmental innovation adoption in vietnam: mediating roles of firms' bargaining power and credit and institutional constraints. Ecol. Econ. 185, 107042 https://doi.org/10.1016/j.ecolecon.2021.107042.
Ha, L.T., Thanh, T.T., 2022. Effects of digital public services on trades in green goods: does institutional quality matter? Journal of Innovation & Knowledge 7 (1), 100168. https://doi.org/10.1016/j.jik.2022.100168.
Hall, S., Foxon, T.J., Bolton, R., 2016. Financing the civic energy sector: how financial institutions affect ownership models in Germany and the United Kingdom. Energy Res. Social Sci. 12, 5–15. https://doi.org/10.1016/j.erss.2015.11.004.
Hallak, J.C., 2006. Product quality and the direction of trade. J. Int. Econ. 68 (1), 238–265. https://doi.org/10.1016/j.jinteco.2005.04.001.
Hoffman, R.C., Munemo, J., Watson, S., 2016. International franchise expansion: the role of institutions and transaction costs. J. Int. Manag. 22 (2), 101–114. https://doi.org/10.1016/j.intman.2016.01.003.
Im, K.S., Pesaran, M.H., Shin, Y., 2003. Testing for unit roots in heterogeneous panels. J. Econom. 115 (1), 53–74. https://doi.org/10.1016/S0304-4076(03)00092-7.
Ji, Q., Zhang, D., 2019. How much does financial development contribute to renewable energy growth and upgrading of energy structure in China? Energy Pol. 128, 114–124. https://doi.org/10.1016/j.enpol.2018.12.047.
Jones, M.V., Coviello, N., Tang, Y.K., 2011. International Entrepreneurship research (1989–2009): a domain ontology and thematic analysis. J. Bus. Ventur. 26 (6), 632–659. https://doi.org/10.1016/j.jbusvent.2011.04.001.
Kao, C., 1999. Spurious regression and residual-based tests for cointegration in panel data. J. Econom. 90 (1), 1–44. https://doi.org/10.1016/S0304-4076(98)00023-2.
Kim, D.-H., Lin, S.-C., Suen, Y.-B., 2010. Are financial development and trade openness complements or substitutes? South. Econ. J. 76 (3), 827–845.
Kim, K., 2018. Proactive versus reactive corporate environmental practices and environmental performance. Sustainability 10 (1), 97. https://doi.org/10.3390/su10010097.
Krishna, P., Maloney, W.F., 2011. Export Quality Dynamics. World Bank. https://doi.org/10.1596/1813-9450-5701.
Lages, L.F., Silva, G., Styles, C., 2009. Relationship capabilities, quality, and innovation as determinants of export performance. J. Int. Market. 17 (4), 47–70. https://doi.org/10.1509/jimk.17.4.47.
Le, H.T., Hoang, D.P., 2021. Economic Sanctions and Environmental Performance: the Moderating Roles of Financial Market Development and Institutional Quality. Environmental Science and Pollution Research. https://doi.org/10.1007/s11356-021-17103-3.
Le, T.-H., Le, H.-C., Taghizadeh-Hesary, F., 2020a. Does financial inclusion impact CO2 emissions? Evidence from Asia. Finance Res. Lett. 34, 101451 https://doi.org/10.1016/j.frl.2020.101451.
Le, T.-H., Nguyen, C.P., Park, D., 2020b. Financing renewable energy development: Insights from 55 countries. Energy Res. Social Sci. 68, 101537 https://doi.org/10.1016/j.erss.2020.101537.
Lei, W., Liu, L., Hafeez, M., Sohail, S., 2022. Do economic policy uncertainty and financial development influence the renewable energy consumption levels in China? Environ. Sci. Pollut. Control Ser. 29 (5), 7907–7916. https://doi.org/10.1007/s11356-021-16194-2.
Leibovici, F., 2021. Financial development and international trade. J. Polit. Econ. 129 (12), 3405–3446. https://doi.org/10.1086/716564.
Levin, A., Lin, C.-F., James Chu, C.-S., 2002. Unit root tests in panel data: asymptotic and finite-sample properties. J. Econom. 108 (1), 1–24. https://doi.org/10.1016/S0304-4076(01)00098-7.
Levine, R., 1997. Financial development and economic growth: views and agenda. J. Econ. Lit. 35 (2), 688–726.
Liao, H., Cao, H.-S., 2013. How does carbon dioxide emission change with the economic development? Statistical experiences from 132 countries. Global Environ. Change 23 (5), 1073–1082. https://doi.org/10.1016/j.gloenvcha.2013.06.006.
Liu, R., Koehler, A., Gailhofer, P., Gensch, C.-O., Wolff, F., 2019. Impacts of the Digital Transformation on the Environment and Sustainability.
Manova, K., 2013. Credit constraints, heterogeneous firms, and international trade. Rev. Econ. Stud. 80 (2), 711–744. https://doi.org/10.1093/restud/rds036.
Maskus, K.E., Milani, S., Neumann, R., 2019. The impact of patent protection and financial development on industrial R&D. Res. Pol. 48 (1), 355–370. https://doi.org/10.1016/j.respol.2018.09.005.
Nasir, M.A., Duc Huynh, T.L., Xuan Tram, H.T., 2019. Role of financial development, economic growth & foreign direct investment in driving climate change: a case of emerging ASEAN. J. Environ. Manag. 242, 131–141. https://doi.org/10.1016/j.jenvman.2019.03.112.
Nguyen, C.P., Su, T.D., 2021. Export quality dynamics: multidimensional evidence of financial development. World Econ. 44 (8), 2319–2343. https://doi.org/10.1111/twec.13103.
Okah Efogo, F., 2020. Financial development and african participation in global value chains. In: Seck, D. (Ed.), Financing Africa's Development: Paths to Sustainable Economic Growth. Springer International Publishing, pp. 33–52. https://doi.org/10.1007/978-3-030-46482-0_3.
Pan, X., Uddin, Md K., Han, C., Pan, X., 2019a. Dynamics of financial development, trade openness, technological innovation and energy intensity: evidence from Bangladesh. Energy 171, 456–464. https://doi.org/10.1016/j.energy.2018.12.200.
Pan, X., Uddin, Md K., Saima, U., Guo, S., Guo, R., 2019b. Regime switching effect of financial development on energy intensity: evidence from Markov-switching vector error correction model. Energy Pol. 135, 110995 https://doi.org/10.1016/j.enpol.2019.110995.
Patnaik, R., 2018. Impact of industrialization on environment and sustainable solutions – reflections from a South Indian region. IOP Conf. Ser. Earth Environ. Sci. 120, 012016 https://doi.org/10.1088/1755-1315/120/1/012016.

Pedroni, P., 2004. Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econom. Theor. 20 (3), 597–625. https://doi.org/10.1017/S0266466604203073.
Pesaran, M.H., 2021. General diagnostic tests for cross-sectional dependence in panels. Empir. Econ. 60 (1), 13–50. https://doi.org/10.1007/s00181-020-01875-7.
Pesaran, M.H., Smith, R., 1995. Estimating long-run relationships from dynamic heterogeneous panels. J. Econom. 68 (1), 79–113. https://doi.org/10.1016/0304-4076(94)01644-F.
Porter, M.E., 1980. Competitive Strategy: Techniques for Analyzing Industries and Competitors (SSRN Scholarly Paper ID 1496175). Social Science Research Network. https://papers.ssrn.com/abstract=1496175.
Porter, M.E., van der Linde, C., 1995. Toward a new conception of the environment-competitiveness relationship. J. Econ. Perspect. 9 (4), 97–118. https://doi.org/10.1257/jep.9.4.97.
Rankin, N., Schöer, V., 2013. Export destination, product quality and wages in a middle-income country. The case of South Africa. Rev. Dev. Econ. 17 (1), 64–73. https://doi.org/10.1111/rode.12015.
Rubashkina, Y., Galeotti, M., Verdolini, E., 2015. Environmental regulation and competitiveness: empirical evidence on the Porter Hypothesis from European manufacturing sectors. Energy Pol. 83, 288–300.
Shahbaz, M., Nasir, M.A., Roubaud, D., 2018. Environmental degradation in France: the effects of FDI, financial development, and energy innovations. Energy Econ. 74, 843–857. https://doi.org/10.1016/j.eneco.2018.07.020.
Shobande, O.A., Ogbeifun, L., 2022. The criticality of financial development and energy consumption for environmental sustainability in OECD countries: evidence from dynamic panel analysis. Int. J. Sustain. Dev. World Ecol. 29 (2), 153–163. https://doi.org/10.1080/13504509.2021.1934179.
Stein, J.C., 1989. Efficient capital markets, inefficient firms: a model of myopic corporate behavior. Q. J. Econ. 104 (4), 655–669. https://doi.org/10.2307/2937861.
Svirydzenka, K., 2016. Introducing a New Broad-Based Index of Financial Development (SSRN Scholarly Paper ID 2754950). Social Science Research Network. https://papers.ssrn.com/abstract=2754950.
Sweet, C.M., Eterovic Maggio, D.S., 2015. Do stronger intellectual property rights increase innovation? World Dev. 66, 665–677. https://doi.org/10.1016/j.worlddev.2014.08.025.
Teng, C.-C., Lu, C.-H., 2016. Organic food consumption in Taiwan: motives, involvement, and purchase intention under the moderating role of uncertainty. Appetite 105, 95–105. https://doi.org/10.1016/j.appet.2016.05.006.
The Global Risks Report 2021, 2021. World economic forum. Retrieved November 20. https://www.weforum.org/reports/the-global-risks-report-2021/.
Topcu, M., Payne, J.E., 2017. The financial development–energy consumption nexus revisited. Energy Sources B Energy Econ. Plann. 12 (9), 822–830. https://doi.org/10.1080/15567249.2017.1300959.
Walker, D.A., 1989. Financing the small firm. Small Bus. Econ. 1 (4), 285–296.
Westerlund, J., 2005. New simple tests for panel cointegration. Econom. Rev. 24 (3), 297–316. https://doi.org/10.1080/07474930500243019.
Wiser, R.H., Pickle, S.J., 1998. Financing investments in renewable energy: the impacts of policy design. Renew. Sustain. Energy Rev. 2 (4), 361–386. https://doi.org/10.1016/S1364-0321(98)00007-0.
Yang, F., 2019. The impact of financial development on economic growth in middle-income countries. J. Int. Financ. Mark. Inst. Money 59, 74–89. https://doi.org/10.1016/j.intfin.2018.11.008.
Żelazna, A., Bojar, M., Bojar, E., 2020. Corporate social responsibility towards the environment in lublin region, Poland: a comparative study of 2009 and 2019. Sustainability 12 (11), 4463. https://doi.org/10.3390/su12114463.
Zhuang, W., Luo, X., Riaz, M.U., 2021. On the factors influencing green purchase intention: a meta-analysis approach. Front. Psychol. 12. https://www.frontiersin.org/article/10.3389/fpsyg.2021.644020.
Zugravu-Soilita, N., 2018. The impact of trade in environmental goods on pollution: what are we learning from the transition economies' experience? Environ. Econ. Pol. Stud. 20 (4), 785–827.