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Does financial globalisation matter for environmental quality? A sustainability perspective of Asian economies

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ABSTRACT

The study aims to explore the asymmetric impact of financial globalisation on renewable CO2 emissions for selected Asian economies for a time span from 1990 to 2019. A sample of 35 economies is selected on the basis of the availability of data. To get the estimates of the variables, the analysis has applied FMOLS and DOLS estimation methods. The linear estimate of financial globalisation in the FMOLS model is negative and significant but positive and insignificant in the DOLS model. The estimates attached to positive financial globalisation are negatively significant in both FMOLS and DOLS models, implying that an increase in financial globalisation causes the environmental quality to improve. Similarly, the estimates attached to negative financial globalisation in both FMOLS and DOLS are negative and suggest that a fall in financial globalisation causes the environmental quality to deteriorate. The magnitudes of positive and negative changes are different; hence, they have a significantly different impact on environmental quality. The robust results clearly indicate that the effects of financial globalisation on CO2 emissions are asymmetric. Therefore, the policymakers should focus on positive as well as negative changes in financial globalisation while considering the impact of financial globalisation on CO2 emissions in Asian regions.

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1. Introduction

The ongoing process of globalisation has accelerated the process of financialization and production (Erdoğan et al., 2020). On the flip side, with increasing production and financial growth the demand for energy has tremendously increased. According

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to BP (2019) the use of primary energy consumption has surged from a ten-year annual average rate of 1.5% to 2.9% in 2018. The primary energy in the form of oil, gas and coal has environmental repercussions Climate changes are mainly attributed to increasing greenhouse gases (GHGs), stemming from energy consumption growth (Ullah et al. 2020; Majeed et al., 2020; Ozturk et al., 2021). Carbon dioxide (CO2) emission in 2018 was 33,890 million tons reflecting a growth of 2%, which is highest over the last 7 years (BP, 2019). According to IPCC (2014), fossil fuels and industrial growth contribute 65% of global GHGs emissions. Owing to degrading ecological systems and better awareness of preserving the environment has led many researchers to explore the links of income growth, globalisation, and financial development with environmental degradation.

Financial liberalisation representing globalisation enhances the incentives for research and development (R&D) activities related to foreign direct investment (Dauvergne & Lister, 2012). High openness to trade owing to globalising economies influences the environment through two effects namely 'the scale effect and the composition effect'. The scale effect represents an increase in production scale due to more trade (Bilgili et al., 2020). According to this perspective, the demand for foreign goods and services increases as a result of high degree of globalisation (Le et al., 2016). As the production of goods and services tend to increase, the pressure on natural resources also escalates, degrading the environment. On the contrary, the composition effect represents the association between trade openness and production composition in globalising countries. It is evident from the fact that rich countries focus on clean industrialisation, while poor countries prioritise dirty industrialisation. That is, economies with less stringent environmental laws focus on dirty industry and incentivize pollution-intensive industries from the rest of the world. In such a scenario, polluting firms move from rich countries to the poor countries, such as phenomenon is also referred to as pollution haven hypothesis (Solarin et al., 2017).

Whereas an improved financial structure facilitates capital access which, in turn, increases growth and living standard, it also increases demand for more energy consumption which arguments global carbon emission (Saud et al., 2020). On the other side, a better financial setup and abundant financial capital motivate the adoption of clean production process through increasing the purchase of modern technology that are more energy-conserving and supports environmental conservation and sustainability. Besides, financial improvements and capital market openness stimulate links between financial mechanisms and FDI which might bring green production methods and R& D led clean production actives in the host economies (Sbia et al., 2017).

Prior studies consider the impact of main macroeconomic variables on CO2 emissions such as national income, innovation, FDI, trade, urbanisation, and energy consumption (Ahmad et al., 2020; Ahmad & Zheng, 2021; Xin et al., 2021; Khattak & Ahmad, 2022; You et al., 2022). Limited studies are exploring the nexus between financial globalisation and environmental pollution in emerging and BRICS nations (Ulucak et al., 2020; Sadiq et al., 2022); however, none of the studies has examined the nexus between financial globalisation and environmental sustainability nexus for Asian economies. Additionally, the existing studies are examining the linear effect of financial development on pollution emissions by employing the single equation

method, which can produce inconsistent and biased estimates. Therefore, our study adopted a nonlinear approach to provide a more appropriate understanding of the asymmetric impact of financial globalisation on CO2 emissions for Asian economies. From the literature, it is obvious that financial globalisation can have both negative and positive impacts on environmental performance. Thus, to capture the influence of both negative and positive shocks in financial globalisation, we adopted nonlinear estimation approaches. The literature confirmed that an increase in financial globalisation reduces CO2 emissions while a decrease in financial globalisation results in increased CO2 emissions.

Given the above premises, the present study explores the effects of financial globalisation on environmental quality for Asian economies employing second-generation panel time series methods, covering the period 1980 to 2019. This research extends the existing literature in several ways. This study employs a new index of financial globalisation suggested by Gygli et al. (2019) instead of the conventional globalisation index. The index provided by Gygli et al. (2019) has both de facto and de jure measures of globalisation including its three dimensions namely economic, social and political globalisation. Economic globalisation is sub-divided into financial and trade globalisation. Second, this study provides empirical evidence for Asian economies in a comparative setting. Third, in the past, the empirics have relied on the financial development index to represent the financial sector; however, this analysis relies on financial globalisation. Fourth, the findings of the available literature are inconclusive, and we cannot say with certainty whether the relationship between financial performance is positive or negative; hence, we need an in-depth investigation. Lastly, this analysis relies on the nonlinear estimation technique instead of a linear one due to the asymmetric behaviour of most macroeconomic variables.

We propose to answer this research question in our analysis: Does financial globalisation affect environmental quality? The present study contributes to the existing literature theoretically and methodically. The methodological contribution is that this research is the first one in the case of panel data considering the impact of positive shock and negative shock in financial globalisation on CO2 emissions. According to our limited knowledge, only one study is available examining the asymmetric impact of financial development on economic growth and energy consumption in India (Shahbaz et al., 2016). The theoretical contribution of our study is that it has examined the role of financial globalisation on CO2 emissions for Asian economies. However, previously done studies capture the role of financial development. In our view, financial globalisation is more appropriate for a policymaking perspective and the findings can provide an in-depth understanding of the positive and negative shocks to financial globalisation and CO2 emissions.

The findings of the study will offer suitable policy suggestions for the Asian economies. Besides, the results will suggest how policymakers of the Asian economies can intervene to regulate financial globalisation towards environmental sustainability outcomes. Lastly, the climate effects of global integration demonstrate a problematic concern for the Asian economies and many of them are turning their policies towards inward financialization. Hence, the future of the global economy relies on the response of the economies such as China. It is noteworthy that most Asian economies

have a high population which can have an important impact on environmental indicators. Besides, the financial sector is also growing in these economies because foreign investors are moving their capital into these countries owing to high perspectives for marginal returns of their capital. Following these circumstances of the Asian economies, exploring the association between financial globalisation and environmental quality requires an urgent focus of the researchers.

2. Literature review

Recently, the studies that have investigated the role of financial and economic development in affecting environmental quality have gained popularity and grabbed the attention of empirics worldwide. In the available literature, it is mentioned that the adverse impact of economic affluence can be controlled through improvement in infrastructure and the deployment of energy-saving technologies (Zafar et al., 2021, Tahir et al., 2021; Destek & Sarkodie, 2019; Majeed & Mazhar, 2019; Al-Mulali et al., 2015; Ozturk & Acaravci, 2013). According to Kreuger (1995), the relationship between economic growth and environmental quality forms a U-shaped relationship, which is famously called the environmental Kuznets curve (EKC). The U-shaped relationship simply implies that environmental quality improves during the early stages of affluence and improves at later stages. (Tamazian et al., 2009). Similar results are also found by Murshed and Dao (2020) and Murshed (2021) for South Asia.

The links between financial development with environmental performance are explored by many existing studies (see Zafar et al., 2021, Tahir et al., 2021; Omri et al., 2015; Boutabba, 2014; Sadorsky, 2011; Furuoka, 2015). The main proxies of financial development used by the current literature include credit to the private sector, cash liabilities, and bank deposits as a ratio to GDP (Majeed & Mazhar, 2019; Saud et al., 2020; Sadorsky, 2011). These studies confirm a significant link between financial performance and environmental quality; however, the direction of the effect is intensively debated among researchers. These studies incorporate income growth, energy use, urban population, trade, foreign direct investment, and globalisation into their econometric models (see Saud et al., 2020; Majeed & Mazhar, 2019). Similarly, Murshed et al. (2021) and Murshed et al. (2022) consider renewable energy transition in supporting environmental quality in South Asia and the Next 11 countries.

The existing literature has explored financial development and environmental quality nexus in the following country setting. One group of studies has focussed on country-specific evidence (Majeed et al., 2020; Charfeddine & Ben Khediri, 2016; Boutabba, 2014; and Ozturk & Acaravci, 2013), In this group, studies mainly employ 'autoregressive distributed lag (ARDL)' approach, 'vector error correction model (VECM)', various cointegration and causality test (see Boutabba, 2014; Ozturk & Acaravci, 2013). The other group of studies has mainly focussed on cross-country analysis (Majeed & Mazhar, 2019; Salahuddin et al., 2015). These studies have used diverse panel data methodologies which can be classified into two strands. The first strand has used first-generation panel data approaches and GMM (see Al-Mulali et al., 2015; Sadorsky, 2011). The second strand has mainly used the second-generation time series analysis (see Shahbaz et al., 2016; Saud et al., 2020).

The literature on the role of financial sector in environmental conservation provides indecisive evidence. One strand of the studies confirms the environmental improving effect of financial development (see Al-Mulali et al., 2015; Tamazian et al., 2009), another strand of the literature has shown environmental damaging effects of financial development on environmental quality (see Shahbaz et al., 2016; Omri et al., 2015). Last, a small group of studies has declared the insignificant role of the financial sector in environmental quality (see Destek & Sarkodie, 2019; Ozturk & Acaravci, 2013). In the same vein, Murshed et al. (2020) and Khan et al. (2022) noted that financial development has an important role in environmental sustainability in South Asia and Next Eleven countries.

In the context of Asian economies, Siddique et al. (2016) used panel cointegration and explored that financial development decreases carbon emissions. Hamdan et al. (2018) utilise the data of five ASEAN nations and concluded the favourable impact of financial development on environmental quality. Similarly, Zaidi et al. (2019) found environmental improving effects of financial development for APEC economies over the period 1990–2016. Contrary to this, Zafar et al. (2021) and Tahir et al. (2021) found environmental deteriorating effects of financial development on environmental quality similar results for Asia from 1990 to 2017 and South Asia from 1990 to 2014, respectively. These studies highlight that development in the financial sector may allow people to consume more energy-intensive items such as cars, fridges, and air conditioners that deteriorate the air quality. Thus, the literature is not providing clear evidence in the case of Asian economies. These studies assume a linear link between financial development and emissions and ignore hidden nonlinear effects. Moreover, these studies do not consider the role of financial globalisation in explaining the nexus of the financial sector with environmental quality.

Ulucak et al. (2020) explore the association between financial globalisation and environmental quality in the case of emerging countries employing annual data over the period 1974–2016. Their findings confirm a favourable effect of financial globalisation on environmental quality. The strength of their analysis is that they frame the importance of financial globalisation in the debate of financial development and environmental quality nexus. The limitation of their analysis is that they assume the linear effects of financial globalisation on environmental performance. Ahmad et al. (2021) also found similar results for G-7 economies over the period 1980–2016.

To the authors' best information, no prior study has analysed the association between financial globalisation and environmental quality for Asian countries using the advanced panel data estimation approach. None of the prior studies has explored the impact of financial globalisation on CO2 emissions in the Asian region; this is the pioneer study in this regard. The majority of prior studies have examined the symmetric impact of globalisation on economic growth and the environment, and relatively no study has examined the asymmetric impact of financial globalisation on environmental performance, especially in the context of the Asian region. The prior studies generally use the KOF index as a measure of globalisation and linear estimation approaches. In this way, the empirical literature has a gap that this study intends to fill by utilising a more specific measure of financial globalisation and nonlinear estimation approaches. The present study determines the effects of financial

globalisation on environmental quality for Asian economies employing nonlinear estimation methods, covering the period 1990 to 2019.

3. Model and methods

The past theoretical and empirical literature has identified financial globalisation to be the main determinant of CO2 emissions. As such, we modify the CO2 emissions model estimated by Ulucak et al. (2020), thus we begin with the following long-run model:

$$CO_{2,it} = \varphi_0 + \varphi_1 FG_{it} + \varphi_2 GDP_{it} + \varphi_3 UP_{it} + \varphi_4 EI_{it} + \alpha_{it} + \varepsilon_{it} \quad (1)$$

In equation, CO2 emissions are expressed by CO2 that determine by financial globalisation (FG), GDP per capita (GDP), urban population (UP), and energy intensity (EI). As discoursed in the earlier section, an estimate of φ_1 could be positive or negative. Where φ_2, φ_3, φ_4 denote coefficients estimates of GDP, urban population, energy intensity, respectively, while α_{it} unobserved individual effects in the panel model. Our study argues that financial globalisation could affect CO2 emissions asymmetrically. We have decomposed the only focussed variable (FG) for nonlinear analysis.

$$\eta = \begin{cases} FG^{+} \text{ if } \Delta FG_{it} > 0 \\ FG^{-} \text{ if } \Delta FG_{it} < 0 \end{cases} \quad (2)$$

To capture the positive and negative shocks of financial globalisation in the CO2 equation, as Ahmad et al. (2021) and Khattak et al. (2022) claimed and the new model can be written as:

$$CO_{2,it} = \varphi_0 + \varphi_1 FG^{+}_{it} + \varphi_2 FG^{-}_{it} + \varphi_3 GDP_{it} + \varphi_4 UP_{it} + \varphi_5 EI_{it} + \alpha_{it} + \varepsilon_{it} \quad (3)$$

In this study, we have used panel data. As a result, the number of observations increased manifold and we have a greater degree of variability, more information, and a highly efficient data set (Hsiao, 2022; Baltagi, 1995). Moreover, due to a large number of observations, we do not need to face the problem of the degree of freedom. However, traditional cross-sectional and time-series estimation techniques cannot handle panel data. Instead, special panel data techniques are required to deal with the panel data analysis are required (e.g., fixed effects, random effects). But, there are a few disadvantages attached to these techniques that are not applicable in macro panels where both T and N are large. In such a situation where we are dealing with the macro panels we turn our attention to other estimation techniques like pooled ordinary least square (POLS), fully modified ordinary least square (FMOLS), and dynamic ordinary square (DOLS).

POLS is a method that runs a large single regression after adding all the temporal and spatial observations by ignoring the time series and cross-sectional characteristics of the data set. Pooled OLS is an efficient technique when we use a different sample

Table 1. Definitions and sources.

Variables	Symbol	Definitions	Sources
CO2 emissions	CO2	CO2 emissions (kt)	World bank
Financial globalisation	FG	Financial globalisation index	KOF Swiss Economic Institute
GDP per capita	GDP	GDP per capita (constant 2010 US$)	World bank
Urban population	UP	Urban population	World bank
Energy intensity	EI	GDP per unit of energy use (constant 2017 PPP $ per kg of oil equivalent)	World bank

for each time period (Wooldridge, 2010). However, unobserved heterogeneity, if available in the data set, can produce misleading and inefficient results because POLS cannot account for heterogeneity in data (Gaibulloev et al. 2014). Hence, in this analysis, we have employed two advanced estimation techniques that can take care of the problems encountered in the case of POLS. One of the main advantages of the FMOLS and DOLS are their power to remove the presence of endogeneity and serial correlation in the model. The

FMOLS way of dealing with the issues with endogeneity and serial correlation is non-parametric, whereas the DOLS applied the parametric approach. The parametric approach includes leads and lags for independent variables that are crucial in resolving the above-stated problems (Kao & Chiang, 2001). Moreover, if the sample size is small, the DOLS is an efficient estimator (Dogan & Seker, 2016). Further, dealing with cross-sectional dependence is tricky, and the DOLS can deal with it by providing consistent and unbiased estimates. Heterogeneity is another issue that emerges during panel analysis, and the weighted criteria of FMOLS and DOLS can overcome this problem (Jebli et al., 2016). Checking robustness has become almost a norm these days, and we have followed the practice by applying PMG-ARDL of Eberhardt (2012) and CS-ARDL of (Chudik & Pesaran, 2015). These methods have several benefits, including the power to deal with cross-sectional dependence, heterogeneity, and endogeneity, besides capturing the short-run dynamics.

4. Data

The study aims to explore the impact of financial globalisation on CO2 emissions for selected Asian economies for a time span from 1990 to 2019. A sample of 35 economies is selected based on the availability of data. The list of economies is reported in Appendix Table A1. Table 1 provides extensive information regarding definitions, symbols, and sources of data. The dependent variable CO2 emission is measured by carbon dioxide emissions in kilotons. However, the financial globalisation index is a major focus variable, which is recently used by Ulucak et al. (2020) in the energy and environment literature. According to the previous standard studies, the influence factor of CO2 chiefly includes GDP (Khattak et al., 2020), energy intensity (Xin et al., 2021), and urbanisation (Khan et al., 2019). Thus, these variables are employed as control variables, namely, GDP per capita (constant 2010 US$), urban population, and energy intensity. However, data for the financial globalisation index are extracted from the KOF Swiss economic institute. Table 2 reported the descriptive statistics. The findings of the Jarque–Bera test confirm that all the selected series are normally

Table 2. Descriptive statistics.

	Mean	Median	Max	Min	S.D	Skewness	Kurtosis	Jarque-Bera
CO2	11.11	11.16	16.27	6.846	1.896	0.191	2.511	1.807
FG	3.871	4.007	4.585	2.079	0.511	−0.876	3.114	1.119
GDP	8.509	8.406	11.13	4.890	1.455	−0.023	1.926	2.258
EI	8.202	7.954	22.54	1.231	3.741	0.654	3.602	1.623
UP	16.20	16.20	20.55	12.05	1.764	0.116	2.551	1.559

Source: authors own calculations.

Table 3. VIF.

Variable	VIF	1/VIF
FG	1.58	0.63
GDP	1.46	0.68
UP	1.12	0.89
EI	1.07	0.94
Mean VIF	1.31	

Source: authors own calculations.

Table 4. Cross-sectional dependence and unit root test.

		CO2	FG	GDP	EI	UP
Cross-sectional dependence						
	Pesaran CD	2.444**	7.923***	12.23***	−0.632	7.797***
	P-value	0.014	0.000	0.000	0.531	0.000
CIPS test						
	I(0)	−1.668	0.223	−0.274	−0.672	−1.023
	I(1)	−5.085***	−2.761*	−3.808***	−5.612***	−5.893***

Note: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.1$.
Source: authors own calculations.

distributed. Table 3 depicts that no significant multicollinearity is found between concern variables employing a Variance inflation factor (VIF) threshold of 10.

5. Results and discussion

In panel data analysis, it is important to check the cross-sectional dependence of variables to adopt proper techniques and strategies for panel data. For that purpose, in step one, the study explores the cross-sectional dependence of the variables. There are several tests for the examination of cross-sectional dependence, but this study is getting support from Pesaran's (2004) cross-sectional dependence test. In the second step, in order to achieve a more valid decision about panel regression, stationarity properties of the data have been checked. In this regard, this study employed a cross-sectional Im, Pesaran, and Shin (CIPS) panel unit root test that provides more valid results in the presence of cross-sectional dependence across countries. Table 4 displays the findings of the cross-sectional dependence test and unit root test. The findings of Pesaran test confirm the existence of cross-sectional dependence across economies. The findings of CIPS test confirm that there is no existing mixed order of integration among variables. Table 5 reports the findings of the Pedroni panel cointegration test. The findings of Pedroni panel cointegration test suggest that there exists cointegration among variables of concern such as CO2 emissions, financial globalisation, GDP per capita, urban population, and energy intensity. If the long-run association exists, it confirms that indicators are

Table 5. Pedroni panel cointegration.

	Statistic	Prob.	Weighted Statistic	Prob.
Common AR coefficients (within-dimension)				
V-Stat	−4.380***	0.000	−3.355***	0.000
Rho-Stat	1.608*	0.054	1.070	0.142
PP-Stat	−1.396*	0.081	−2.039**	0.021
ADF-Stat	−1.548*	0.061	−0.966	0.167
Individual AR coefficients (between-dimension)				
Rho-Stat	1.647*	0.050		
PP-Stat	−3.402***	0.000		
ADF-Stat	−1.593*	0.056		

Note: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.1$.
Source: authors own calculations.

Table 6. FMOLS and DOLS estimates (group-wise).

	FMOLS		DOLS		FMOLS		DOLS	
	beta (1)	t-stat	beta (2)	t-stat	beta (3)	t-stat	beta (4)	t-stat
FG	−0.01***	11.4	0.06	1.31				
FG_POS					−0.04***	2.17	−0.12**	2.57
FG_NEG					−0.03	0.39	−0.04***	10.4
GDP	0.94***	14.8	1.09***	6.56	0.84***	12.8	1.02***	8.66
EI	−0.11***	11.6	−0.07***	8.42	−0.11***	11.2	−0.08***	3.42
UP	1.54***	16.8	1.18***	5.55	1.59***	10.5	1.35***	4.12
Post estimation tests								
LM	1.98							
BP	2.01							
RESET	1.32							

Note: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.1$. The absolute t-stat is reported.
Source: authors own calculations.

cointegrated. The findings of Pedroni panel cointegration test confirm the presence of long-run relationships among all selected variables.

The study applied the FMOLS approach to explore the influence of financial globalisation on CO2 emissions for selected Asian economies. The study explored the symmetric and asymmetric association between financial globalisation and environmental quality. Additionally, the study adopted the DOLS approach to confirm the robustness of the findings. In this perspective, Table 6 reports the group-wise symmetric and asymmetric findings of FMOLS and DOLS approaches. The findings of the symmetric FMOLS approach display that financial globalisation put a significant and negative impact on CO2 emissions revealing that financial globalisation results in enhancing environmental quality. The coefficient estimate reveals that in response of 1% upsurge in financial globalisation, CO2 emissions declines by 0.01% in selected Asian economies. However, financial globalisation produces an insignificant impact on environmental quality in the symmetric DOLS model. The coefficient estimate of the asymmetric FMOLS approach infers that positive shock in financial globalisation exerts a significant and negative impact on CO2 emissions; however, negative shock in financial globalisation produces an insignificant impact on CO2 emissions. The finding demonstrates that due to 1% upsurge in positive shock in financial globalisation, CO2 emission reduces by 0.04%. The coefficient estimate of DOLS model infers that due to 1% increase in positive shock in financial globalisation, CO2 emissions declines by 0.12%. In terms of asymmetric findings, the negative shock in financial

globalisation exerts an insignificant impact on CO2 emissions according to FMOLS model. But, in the case of the asymmetric DOLS approach, negative shock in financial globalisation produces a significant and positive effect on CO2 emissions. It shows that due to a 1% decline in financial globalisation, CO2 emission increased by 0.04%.

Our findings are backed by various studies. For instance, Ulucak et al. (2020) denoted that financial globalisation significantly improves the quality of the environment in the case of emerging economies. The study reported that financial globalisation influences environmental performance through two channels, namely the composition effect and the scale effect. Another study done by Kihombo et al. (2022) supports our findings by disclosing that financial globalisation reduces CO2 emissions in WAME economies. In contrast, Sadiq et al. (2022) study contradict our findings by arguing that financial globalisation accelerates environmental deterioration in the BRICS region. Financial globalisation enhances the utilisation of efficient energy technologies for both firms and households, and thus, endorses a sustainable environment. Financial globalization enables the expansion of financial markets. It offers supplementary capital that can be utilised for making an investment in eco-friendly projects, like the renewable energy sector, communication and information technologies, agriculture sector, and construction sector (Ulucak et al., 2020). Moreover, financial globalisation results in significant improvement of environmental quality by mitigating pollution emissions. Thus, financial globalisation may enhance environmental quality through composition and techniques effects by delivering more eco-friendly projects. The study also reported a negative association between financial globalisation and carbon emissions; this result is in line with the findings of Ulucak et al. (2020) in the case of selected emerging economies. Conversely, these results are opposite to the findings of Figge et al. (2017) and Tahir et al. (2021). Financial globalisation contributes to enduring renewable energy evolution through the amalgamation of comparatively green and cleaner energy resources in the domestic energy mix (Murshed & Alam, 2021). The existing stock of the literature also emphasised the opposing environmental influences connected with several types of financial globalisation (Murshed et al., 2021). Moreover, financial globalisation encourages a technological spill-over effect that, in turn, could be effective in lessening environmental degradation. Therefore, the negative impact of financial globalisation on the carbon emissions of Asian economies depicts that financial globalisation is a fundamental mechanism that leads to composition and technique effects that are essential for phasing out the trade-off between environmental deterioration and economic growth. Moreover, this finding infers that financial globalisation increases ecological sustainability via green FDIs in Asian economies. The finding of the negative association between the CO2 emissions and financial globalisation suggests that financial globalisation can account for environmental development in the selected Asian economies.

In terms of control variables, findings of both symmetric and symmetric FMOLS and DOLS models reveal that GDP per capita and urban population are increasing CO2 emissions, however, energy intensity reduces CO2 emissions in Asian economies. The Lagrange Multiplier (LM) test is used to detect the autocorrelation problem in the models. The findings of the test describe that models are free from autocorrelation problems. Ramsey RESET approach is used to detect the misspecification errors on the models.

Table 7. CS-ARDL estimates (group-wise)-robustness.

	PMG-ARDL		CS-ARDL		PMG-ARDL		CS-ARDL	
Variable	Coefficient (1)	t-Stat	Coefficient (2)	t-Stat	Coefficient (3)	t-Stat	Coefficient (4)	t-Stat
Long-run								
FG	−0.07***	2.63	−0.06*	1.87				
FG_POS					−0.07***	2.87	−0.18*	1.87
FG_NEG					−0.17**	2.50	−0.26***	2.65
GDP	0.74***	2.66	0.82***	7.49	0.76**	2.51	1.07*	1.81
EI	−0.09*	1.83	−0.10***	5.69	−0.09***	3.50	−0.15*	1.78
UP	0.89***	9.67	0.91***	7.00	0.93***	5.16	1.02***	5.33
Short-run								
D(FG)	0.01	0.16	0.02	0.43				
D(FG_POS)					0.04	0.56	0.08	1.02
D(FG_NEG)					0.16	0.99	0.16	0.78
D(GDP)	0.62***	5.83	0.66***	6.37	0.61***	5.51	0.70***	6.85
D(EI)	−0.07***	6.87	−0.07***	6.32	−0.07***	6.21	−0.09***	7.28
D(UP)	0.50	0.88	0.48	0.81	0.60	0.66	0.65	0.21
C	2.14***	5.71	2.30***	5.95	2.20***	4.93	0.40**	2.54
ECM(-1)	−0.25***	5.83	−0.27***	6.12	−0.23***	5.09	−0.29***	2.65

Note: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.1$. The absolute t-stat is reported.
Source: authors own calculations.

The results of this test confirm that all the models are specified correctly. Breusch Pagan (BP) tests also confirm that model is free from heteroscedasticity problems.

To confirm the robustness of the ARDL and NARDL models, our study employed PMG-ARDL and CS-ARDL methods. The findings of the PMG-ARDL method and CS-ARDL method for linear and nonlinear approaches have been displayed in Table 7. In the long-run, the coefficient estimates of financial globalisation are found significant and negative in both symmetric and asymmetric regressions of PMG-ARDL and CS-ARDL methods. Hence, it is proved that the impacts of financial globalisation on CO2 emissions are consistent with results obtained from FMOLS and DOLS methods. However, financial globalisation reports a statistically insignificant impact on CO2 emissions in the short-run in symmetric and asymmetric PMG and CS models. The coefficient estimates of control variables are also consistent in both symmetric and asymmetric PMG-ARDL and CS-ARDL models.

In Table 8, the economy-wise FMOLS estimates reveal that positive shock in financial globalisation exerts a significant and negative impact on CO2 emissions in 16 economies, significant and negative impact in 14 economies, and produces a statistically insignificant impact in 5 economies. The negative shock in financial globalisation produces a significant and positive impact on CO2 emissions in 13 economies, a significant and negative impact in 14 economies, and produces a statistically insignificant impact in 8 economies. Findings also reveal that GDP per capita results in enhancing CO2 emissions in 29 economies and result in reducing CO2 emissions in 4 economies. Energy intensity leads to significant improvement in environmental quality in 30 economies and deteriorates environmental quality in 4 economies. The urban population tends to have a positive impact on CO2 emissions in 31 economies and a negative impact in 4 economies.

Table 8. FMOLS and DOLS estimates (Economy-wise).

Country	FG_POS		FG_NEG		GDP		EI		UP	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Armenia	−0.04***	3.45	−1.61***	7.92	1.46***	9.25	−0.21***	6.22	4.72***	7.39
Azerbaijan	−0.22***	9.66	8.93***	2.79	0.36***	3.48	−0.09***	3.79	2.41***	4.59
Bahrain	−1.06***	6.39	0.46***	4.05	1.15***	7.37	−0.12***	8.38	1.06***	5.69
Bangladesh	0.12***	4.61	−0.07***	2.99	0.02	0.44	−0.08***	8.13	1.91***	6.87
Brunei Darussalam	−0.45***	9.29	−0.41***	5.23	1.31***	7.67	−0.07**	2.39	1.43***	3.19
Cyprus	0.11***	3.73	0.06	1.48	0.82***	4.83	−0.05***	8.34	0.43***	6.05
Cambodia	−0.57**	2.46	−1.95***	4.98	−0.22***	2.69	0.01	0.10	3.72***	5.71
China	0.74***	8.55	−1.25***	5.09	1.28**	2.41	−0.23***	8.48	−1.75***	4.42
Georgia	0.91**	2.57	−1.55***	5.12	0.77***	4.93	−0.11***	8.30	8.22***	2.68
India	0.19***	4.81	−0.08	0.72	0.92***	6.53	−0.22***	6.75	1.19***	6.80
Indonesia	−0.22***	12.8	0.11***	11.7	−0.51***	10.2	0.03***	7.46	2.11***	7.16
Iraq	1.32***	4.25	0.31***	5.60	0.76***	8.33	−0.16***	5.52	1.23***	10.8
Iran	0.04	0.52	−0.09	1.12	0.81***	6.46	−0.07**	2.42	0.79***	4.62
Israel	0.59***	6.42	−0.07	0.35	0.11	0.46	−0.14***	8.55	0.71**	2.43
Japan	−0.55***	10.7	−0.41***	6.76	0.96***	9.28	0.04***	5.63	0.82***	8.13
Jordan	0.54***	8.01	−0.52**	2.38	0.29***	4.09	−0.11***	7.29	0.65***	9.16
Kazakhstan	−0.02**	2.13	0.64***	5.42	0.88***	7.98	−0.24***	8.13	1.95***	7.14
Korea, Rep.	−0.04***	4.29	0.29***	12.8	1.62***	4.43	−0.19***	7.18	−2.13**	2.00
Kuwait	0.18***	4.94	−0.71***	8.51	0.53***	2.91	−0.14***	8.26	0.67***	8.97
Malaysia	−0.52***	7.26	−0.12	1.12	−0.26***	7.24	−0.03***	6.27	1.86***	6.81
Mongolia	−0.05***	3.33	0.11***	3.78	1.02***	2.93	−0.22***	3.17	0.56***	4.72
Nepal	−0.95***	14.8	1.12***	7.66	1.93***	2.99	0.07**	2.12	2.04***	5.05
Oman	−0.02	0.15	−0.68***	5.97	1.17***	5.68	−0.09***	8.48	0.63***	9.58
Pakistan	−0.02	1.40	0.22***	10.4	1.84***	9.87	−0.16***	3.60	1.02***	3.41
Philippines	−1.48**	2.26	1.45***	3.59	1.53***	4.02	−0.14***	6.25	4.21***	4.97
Russia	−0.04***	7.24	0.16***	10.4	0.82***	4.65	−0.12***	8.67	3.95***	6.22
Saudi Arabia	0.23***	6.15	−0.16***	4.97	1.36**	2.09	−0.09***	3.77	0.44***	6.82
Singapore	−0.86***	5.54	−5.82***	6.07	0.12***	2.94	−0.01***	7.13	0.55***	5.14
Sri Lanka	0.52***	4.82	0.23***	7.72	1.85***	5.77	−0.13***	9.80	1.95***	4.31
Thailand	0.15**	2.02	0.51***	3.23	1.39***	8.56	−0.16***	9.53	−0.49***	4.10
Turkey	0.14***	6.96	0.02	1.03	1.04***	5.22	−0.08***	3.27	0.33***	4.28
UAE	−0.14***	3.91	0.01	0.28	0.73***	6.02	−0.07***	4.41	0.94***	9.54
Vietnam	0.42***	5.39	−1.47**	2.21	2.97***	11.8	−0.03**	2.18	−3.14***	8.37
Myanmar	−0.17	0.27	1.01**	2.45	−1.88***	4.03	0.21***	3.70	10.9***	5.74
Uzbekistan	−0.02	0.38	0.16	1.34	0.61***	7.22	−0.25***	8.64	0.37***	4.33

Note: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.1$. The absolute t-stat is reported.
Source: authors own calculations.

6. Conclusion and policy implications

Since the last few decades, several economies have undergone the procedure of rapid financial and economic globalisation, well-defined as the amalgamation of the economies of the world through an aggregate arrangement of multilateral and bilateral, investment and regional trade agreements. Meanwhile, economies are also experiencing substantial upsurges in CO2 emissions. How closely are financial globalisation and CO2 emissions trends connected? In other words, to what extent is financial globalisation affects the environmental quality of a country? The present study aims to explore the impact of financial globalisation on CO2 emissions for 35 selected Asian economies for a time span from 1990 to 2019. The study adopted the FMOLS approach to examine the influence of financial globalisation on CO2 emissions and the DOLS approach is used to confirm the robustness of the findings. For short-run asymmetries, PMG-ARDL and CS-ARDL tests are used. The study explored the symmetric and asymmetric association between financial globalisation and environmental quality. The group-wise finding of the symmetric FMOLS approach displays that

financial globalisation results in enhancing environmental quality. The group-wise finding of the asymmetric FMOLS approach infers that positive shock in financial globalisation produces a negative impact on CO2 emissions; however, negative shock in financial globalisation has an insignificant effect on CO2 emissions. The findings of the asymmetric DOLS model also provide similar kinds of findings. The PMG-ARDL and CS-ARDL support our hypothesised and empirical nexus between financial globalisation and CO2 emissions.

Based on our findings we have provided some important policies for the concerned stakeholders. First and foremost, the results are clearly asymmetric in nature implying that environmental quality responds differently to a positive and negative change in financial globalisation. The magnitudes of positive and negative changes are different; hence, they have a significantly different impact on environmental quality. Therefore, the policymakers should focus on positive as well as negative changes in financial globalisation while considering the impact of financial globalisation on CO2 emissions in Asian economies. Second, our findings suggest that an increase in financial globalisation has improved the environmental quality of Asian economies; therefore, these economies should be integrated into the world financial system as much as possible. In order to achieve higher financial globalisation, the government of Asian economies should focus on financial liberalisation and political structure that could attract more foreign capital from abroad. The government should also keep an eye that these foreign investments should not be utilised in dirty technologies and projects. Third, governments should provide funds to those industries that adopt more energy-efficient technologies. Increasing energy efficiency and reducing energy intensity by providing financial support to the firms should be the ultimate goal of the government for a sustainable environment. Lastly, the Asian economies should attempt to speed up the process of economic growth to achieve that level of economic growth where the environmental quality started to improve. However, Asian economies should use pro-environment, clean, and green technologies to achieve a threshold level of economic growth that does not put an extra burden on the environment.

Last but not least we have provided some limitations of the study and future course of action for other researchers. The biggest limitation of the study is that we do not include each factor of financial globalisation in the analysis. Therefore, future studies should try to use estimation methods that could address this issue. Moreover, the scope of the studies could be further enhanced to other regions and the researchers should target the countries and regions which are integrated more into the world economy. Furthermore, the asymmetric analysis is more close to the real world; hence, future studies should also apply the asymmetric analysis for other countries and regions.

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Appendix

Table A1. List of country.

Armenia	Iraq	Pakistan
Bahrain	Japan	Russia
Azerbaijan	Israel	Philippines
Bangladesh	Jordan	Saudi Arabia
Brunei	Kazakhstan	Singapore
China	Kuwait	Thailand
Cambodia	Korea, Rep.	Sri Lanka
Cyprus	Malaysia	Turkey
India	Myanmar	Uzbekistan
Georgia	Mongolia	UAE
Indonesia	Nepal	Vietnam
Iran	Oman	