Artykuły
Articles

PRZESTRZEŃ Społeczna Social SPACE

Volume 23 Issue 03
2023

Fintech Growth in Asia: A Shift Towards a Net-Zero Carbon Economy

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Abstract

Environmentalists' attention has shifted in the modern era from climate quality to fintech advancements and cryptocurrency mining, which have both increased electricity consumption. Further exploration of fintech advancements is necessary to assess their cost and benefits in order to enhance policy-making and regulatory reform efforts aimed at mitigating climate change. The current literature presents conflicting findings regarding the impact of fintech on environmental quality. Therefore, it is necessary to examine the actual role of fintech innovations in relation to climate quality. This study aims to examine the impact of fintech development on reducing greenhouse gas emissions in selected Asian economies, with the goal of achieving net zero carbon economies. The selection of Asian countries was based on their respective income levels. Our analysis, utilising OLS, 2SLS, and GMM econometric models, reveals a negative relationship between fintech developments and innovations and greenhouse gas emissions. Our findings demonstrate robustness, as we observe consistent outcomes even after controlling for relevant variables and addressing endogeneity concerns. The findings provide valuable insights for governments and policymakers in formulating effective policies to improve environmental quality through the use of fintech advancements.

Keywords: Greenhouse gas emission; CO_2 emission; net zero carbon economy; fintech innovations: fintech developments; GDP

JEL Codes: O14, N75, Q01, Q56, O32, Q55

1. Introduction

Technological advancements have historically impacted the environment, and there has been criticism in both past and recent literature regarding the role of technological progress in causing environmental degradation (Simon & Kahn, 1984). Previous research indicates that technological innovations and advancements are the primary means of addressing various climate challenges (Gray, 1989; Sadiq et al., 2022). Technological advancements have a paradoxical impact on environmental degradation, but they do influence the direction of financial markets (Su et al., 2020a). The conflicting findings in prior research provide a fresh perspective on the discussion surrounding the relationship between financial technology (referred to as fintech) and climate change. According to the UNFCCC (2017) and Green (2018), fintech is necessary for increasing climate finance, reducing carbon emissions in trade, promoting clean energy trade, and effectively addressing environmental degradation. Fintech, however, contributes to the depletion of limited natural resources due to its high electricity consumption (DuPont, 2019; Truby, 2018). Recent research has indicated that policymakers, regulators, and government institutions are consistently assessing fintech ecosystems and their associated costs and benefits, with particular attention to financial growth and environmental considerations (Jiao et al., 2021; Su et al., 2020b).

The discussion surrounding the "Sustainable Development Goals" (SDGs) has gained significant momentum. The primary challenge faced by governments worldwide, as outlined in the 2015 Paris Agreement, is the effective development and implementation of eco-environmental strategies, innovations, and technologies (Ramli et al., 2022). The recent era has witnessed significant technological advancements, leading to enhanced living standards and increased industrial productivity. However, the constant need for replacement and upgrading of software and hardware in technological environments has resulted in the generation of electronic waste (e-waste). The World Economic Forum (WEF, 2019) reported an increase in the production and disposal of electronic and electrical waste from 41.8 million metric tonnes in 2014 to 48.5 million metric tonnes in 2019. Recent research indicates that the electricity consumption associated with fintech, specifically blockchain technologies and cryptocurrencies, is increasing (Dittmar & Praktiknjo, 2019; Schinckus, Canh, & Ling, 2020). The production and maintenance of new technological devices necessitate electricity, leading governments to rely on fossil fuels, thereby contributing to environmental and climatic degradation (Dİlek & Furuncu, 2019).

In this argument, it is important to acknowledge the efficacy of fintech in addressing climate concerns. Fintech systems facilitate the integration of government policies with the green agenda and the establishment of a fintech ecosystem. There is a wide range of literature, both old and recent, that examines the correlation between eco-development, inclusion, diversity, and fintech (Beck et al., 2016; Berger, 2003; Bollaert, Lopez-de-Silanes, & Schwienbacher, 2021; Brunnermeier, 2009; Grinblatt & Longstaff, 2000; Houston et al., 2010). Recent literature explores multiple factors that could potentially address the current challenges of climate degradation (Balsalobre-Lorente, Álvarez-Herranz, & Shahbaz, 2019; Balsalobre-Lorente et al., 2021; Bhattacharya, Churchill, & Paramati, 2017; Bilgili et al., 2021; Caglar, Balsalobre-Lorente, & Akin, 2021; Dogan & Seker, 2016; Raghutla et al., 2021; Ullah, Ozturk, & Sohail, 2021; Zeraibi, Balsalobre-Lorente, & Murshed, 2021). The existing literature on the impact of fintech on climate change is limited. Although there is considerable literature discussing the potential importance of fintech in addressing environmental issues, empirical evidence is scarce.

Only a few recent studies have examined the relationship between cryptocurrencies, blockchains, and environmental quality (Dİlek & Furuncu, 2019; Goodkind, Jones, & Berrens, 2020; Hileman & Rauchs, 2017; Krause & Tolaymat, 2018; O'Dwyer & Malone, 2014). The relationship between fintech advancements and environmental quality has received limited attention, with only a few studies discussed in the literature review conducted by Puschmann, Hoffmann, and Khmarskyi (2020). The authors search for words such as "*fintech*" and "*climate*" and find only ten articles that cover the disciplines of "*environmental sustainability*", "*fintech, agriculture services*", "*fintech payment innovations*", and "*sustainable economic development and fintech*". However, this in-depth literature survey reveals the diverse effects of fintech upon environmental quality. This study contributes to the academic understanding of two emerging areas: environmental degradation and climate change, and the use of fintech as a financial tool for climate mitigation through IT-related services. This study examines the relationship between cryptocurrencies, blockchain technologies, and the environment.

No study has examined the potential of fintech developments to enhance environmental quality. We assume that countries with a more advanced fintech ecosystem experience lower levels of environmental damage. This paper elucidates the connection between the fintech system, its processes, efficacy, and the concept of green financing. The authors suggest that technological progress relies on both corporate investment and public policy, as supported by endogenous growth frameworks (Ramli et al., 2023; Romer, 1994). Therefore, it is recommended that governments create a conducive environment for the development of environmentally sustainable innovations. We conducted a cross-sectional analysis of greenhouse gas (GHG) emissions and the most recent Fintech Index in 8 Asian countries. In addition to the negative connotations, it is evident that fintech advancements can facilitate the transition towards achieving a carbon-neutral economy.

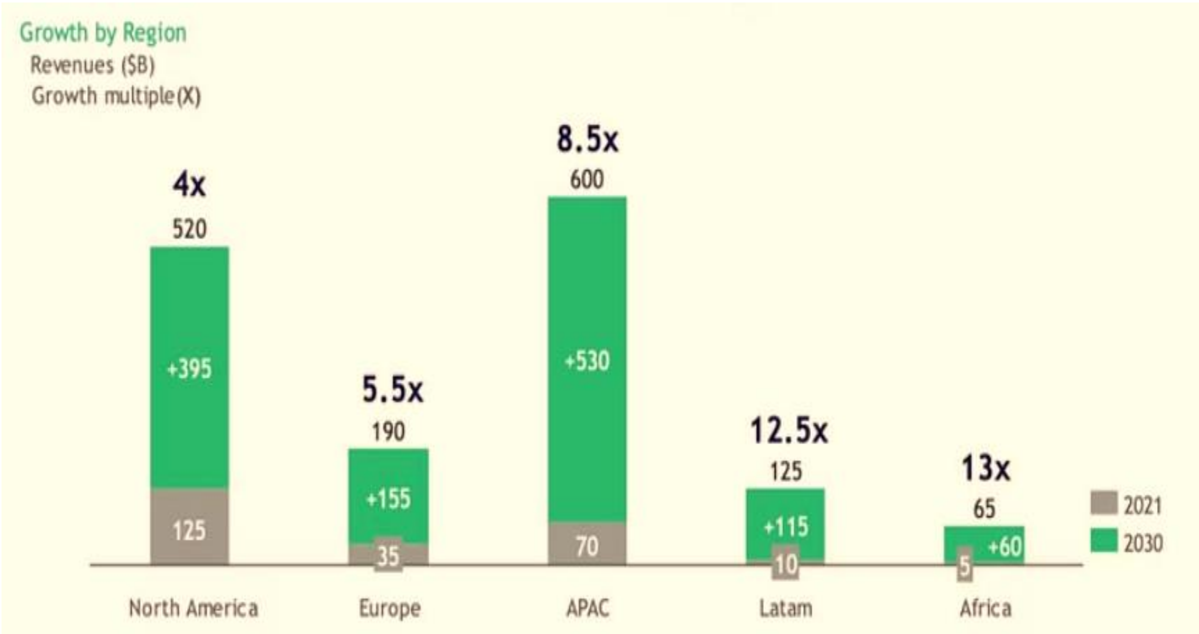

Figure 1: Growth comparison of Fintech Market by region

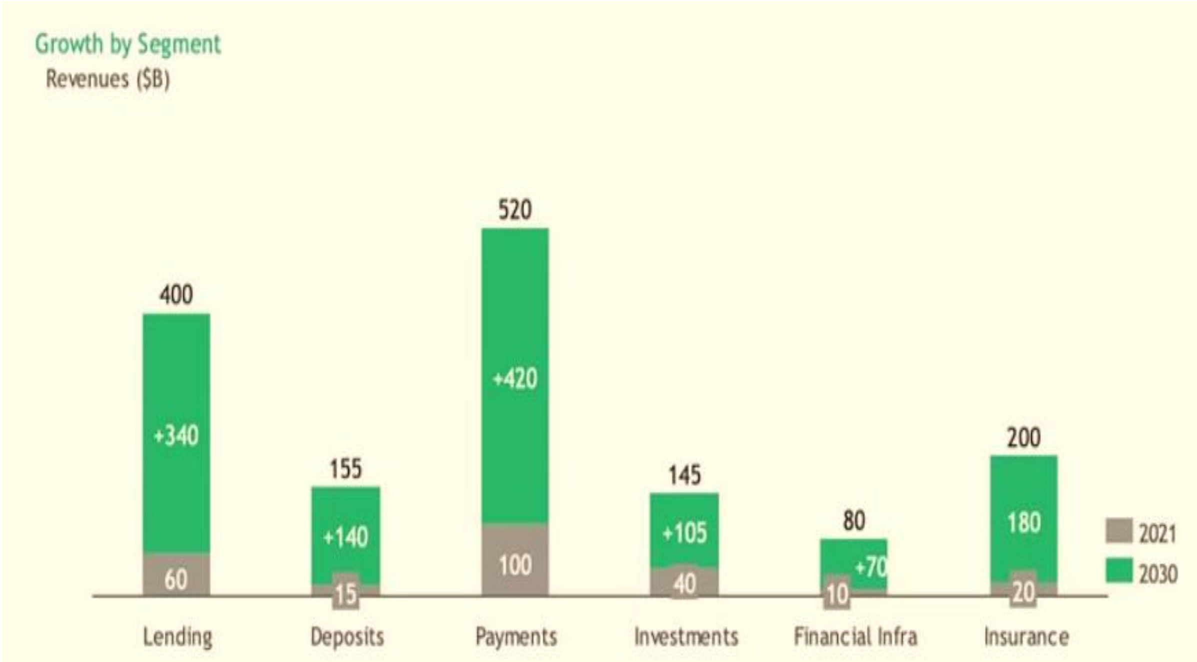

Figure 2: Growth comparison of Fintech Market by segment

The study's findings contribute to resolving the ongoing debate regarding the impact of technological advancement on environmental conditions. The findings suggest that policymakers and regulators should support the advancement of fintech and the transition towards a carbon-neutral economy. The paper is organised as follows: Section 2 provides a literature review on the interconnectedness between technological innovation, fintech development, and climate change. Section 3 outlines the methodological framework employed in the study and provides details on the empirical investigation. This section examines the use of the Fintech Index as a representative measure for assessing the progress of the financial sector and advancements in technology. The empirical findings are presented in Section 4 and analysed in relation to existing literature. The concluding section provides researchers and policymakers with key conclusions and recommendations.

2. Literature Review

Theoretical Framework

Theoretical arguments suggest that financial inclusion has the potential to alleviate environmental and climate issues. The inclusion of finance enables economies to support small and medium businesses and offers individuals the opportunity to access financial products and services at an affordable price. Therefore, facilitating the redirection of investment towards clean technologies. Eco-friendly technologies can achieve both economic and environmental sustainability simultaneously. Financial inclusiveness can effectively mitigate harmful emissions through various platforms. Financial inclusiveness is crucial for farmers in rural areas to meet their financial needs, as credit constraints often limit their ability to access affordable clean energy sources, which are important for maintaining environmental quality. Credit constraints can impede the promotion of green investment in economies. On the contrary, economic activities are typically associated with financial growth, leading to increased energy demand and subsequently higher carbon emissions. Moreover, the availability of these financial services and products can facilitate infrastructure development and support various industrial activities. The integration of finance into technology is anticipated to contribute to environmental sustainability through various channels, including fintech.

Trade openness and export activity can have an impact on the environment based on three key principles; "scale, composition, and technique." The scale effect refers to the phenomenon where increased production leads to a subsequent increase in pollution levels. The composition effect theory suggests that the environmental consequences of export and trade openness are influenced by the industrial structure. This demonstrates that the reliance on abundant natural resources and environmental policies can yield conflicting results. The technique effect suggests that technological advancements and increased income incentivize economies to promote environmentally friendly production, ultimately benefiting the environment (Qin et al., 2021).

The past decade has witnessed substantial financial advancements and technological innovations, which are notable outcomes of the fourth industrial revolution. Industrial growth and technological advancement have significantly benefited the financial industry (Chang et al., 2020). Jiao et al. (2021) state that the fintech sector has experienced significant investment, growth, and returns in recent times (Claessens et al., 2018; Rizvi, Naqvi, & Tanveer, 2017, 2018); Schindler (2017); (Tan, Purba, & Widjaya, 2019). Multiple studies have demonstrated that the growth and profitability of the fintech industry can be attributed to various demographic factors that contribute to the widespread adoption of fintech services. The factors that influence individuals' usage of financial services encompass income levels, education, economic conditions, social systems, and awareness of the convenience, speed, and cost associated with such services.

Previous research (Allen & Gale, 1994; Berger, 2003; Merton, 1992) has also demonstrated the positive effects of financial innovation on the banking sector, industry, and overall economic growth. Beck et al. (2016) argue that the expansion of financial innovation can lead to both positive and negative consequences for the economic and financial development of countries, resulting in increased fragility. The financial crisis resulted from the overextension of credit supply, which can be attributed to the negative consequences of fintech innovation (Brunnermeier, 2009). Grinblatt and Longstaff (2000) and Houston et al. (2010) have found that fintech has several beneficial impacts, including facilitating risk sharing, enhancing credit allocation efficiency, and promoting economic development by filling market gaps. Gozman, Liebenau, and Mangan (2018) argue that the evolving fintech industry has had enduring impacts on global economies. Fintech development has improved the efficiency of the financial system, particularly the banking sector. According to Lee et al. (2021), financial technologies and e-banking have positively impacted performance, competition, and economic and financial activity (Chien et al., 2022; Katz, Koutroumpis, & Martin Callorda, 2014).

Brem, Maier, and Wimschneider (2016) posit that the progress of fintech plays a significant role in the advancement of stock market development. Recent studies have shown that financial development and innovation contribute to the growing importance of financial inclusion and the democratisation of financial services ((Bollaert et al., 2021; Huang, Sadiq, & Chien, 2021). Furthermore, research has established a connection between financial innovation, technological advancements, and the progress of both financial and economic sectors. The existing literature does not sufficiently address the relationship between fintech and environmental quality. Researchers analyse the environmental implications of fintech, specifically focusing on the influence of cryptocurrencies (which are technologically advanced financial products), studies have shown that increased energy and electricity consumption contributes to higher levels of CO_2 emissions and environmental degradation.

According to O'Dwyer and Malone (2014), cryptocurrencies consume energy equivalent to the energy consumption of Ireland. They argue that the increasing energy consumption by Bitcoin miners poses a significant concern. The Bitcoin industry in China relies on coal as its primary energy source, resulting in adverse environmental effects such as degradation, carbon emissions, and ongoing pollution within the country (Hileman & Rauchs, 2017; Nugroho et al., 2020). The coal, thermal, and electrical energy used for Bitcoin mining and transactions have been linked to various negative consequences, including heightened air pollution, global warming, intensified carbon emissions, and increased mortality rates. Krause and Tolaymat (2018) analyse data on four prominent cryptocurrencies to examine their energy usage for mining and the resulting impact on carbon emissions. The study reveals that the energy consumption associated with cryptocurrency mining surpasses that of mining minerals or metals. Cryptocurrency mining significantly contributes to carbon emissions due to its high energy consumption. According to Mora et al. (2018), Bitcoin mining's energy consumption has the potential to contribute to a 2°C increase in global warming.

From 2016 to 2018, Goodkind et al. (2020) use simulation models, such as the exposure-response function and statistical life methods, to look into the link between carbon-related social costs, environmental costs, air pollution, and health damage. The researchers establish a correlation between the mining of four specific cryptocurrencies and the adverse impacts on human health and climate. Notably, they deduce that both the mining of Bitcoin and its associated activities contribute to detrimental effects on human health and the climate. UNFCCC (2017) and Green (2018) present divergent findings regarding the impact of fintech and innovation on climate change. While UNFCCC (2017) highlights the positive influence of fintech on climate finance flow, clean energy trade, and carbon emission trading, Green (2018) also supports these conclusions, suggesting that fintech has a beneficial effect on environmental quality. The studies conducted by UNFCCC (2017), Green (2018), and Goodkind et al. (2020) examine the relationship between cryptocurrencies and environmental quality.

However, there is limited existing literature on the development of fintech in relation to environmental sustainability. Puschmann et al. (2020) conducted a thorough literature review on the environmental impacts of fintech. They identified continuous innovation and sustainability as the primary drivers of the fintech industry. The authors contend that the current research on the matter is constrained in its breadth. Fintech has expanded through the involvement of major technology companies and the introduction of innovative initiatives by small fintech startups. Fintech and innovation can significantly influence climate-related matters. The United Nations has dispatched a task force to examine digital financing, specifically addressing the environmental concerns associated with the fintech sector. It is crucial to examine the relationship between cryptocurrencies, blockchains, financial innovation, and advancements in the financial technology ecosystem and their connection to the economic environment. Thus, we aim to address this gap in the literature by examining the empirical association between the development of financial technology (fintech) and the quality of the climate. This study posits that a country's financial ecosystem plays a crucial role in determining the quality of its environment.

Chapungu et al. (2022) employ the PRISMA methodology to investigate the influence of COVID-19 on carbon emissions. The correlation analysis indicates a decrease in CO2 emissions during the pandemic, leading the authors to suggest that countries are making progress towards achieving net zero emissions by 2050. However, further scientific investigation is necessary to thoroughly examine this phenomenon. In their study, Li et al. (2022) employ a cross-sectional ARDL methodology to ascertain the significance of sustainable finance and climate technologies in attaining green growth and achieving net zero emissions. Lee et al. (2022) and Zhao et al. (2022) argue that financial adaptation and climate finance are crucial strategies for attaining climate quality and achieving net zero emissions. Chen et al. (2023) and Sadiq et al. (2023) examine the four dimensions of transitioning to net zero emission economies, namely industrial, energy, social, and lifestyle. Infrastructure transformation is necessary across various sectors to meet low emissions targets and achieve net zero emissions by 2050. Olarewaju, Dani, and Jabbar (2023) propose a model to facilitate the transition towards a net zero emission economy. This model involves elevating the role of small and medium-sized enterprises (SMEs) in the value-chain, intensifying stakeholder pressure, comprehending the diversity within the zero-emission agenda, and fostering greater community engagement. The authors assert the significance of these factors in attaining sustainable environmental quality.

3. Methodological Framework and Data Description

The theoretical framework of this study is based on recent literature that examines the relationship between technological advancement and carbon emissions. This study aims to examine the influence of fintech innovation and development on greenhouse gas emissions, considering other factors such as trade, capital formation, and income. We utilise the findings of Ang (2007), Soytas and Sari (2009), and Shahbaz, Nasir, and Roubaud (2018) to construct a unified equation model for examining the interrelationships among the variables. Recent studies strongly recommend and support the use of this model (Hasanov, Liddle, & Mikayilov, 2018; Knight & Schor, 2014; Shahbaz et al., 2018; Wang et al., 2020). We incorporate indicators such as gross domestic product (GDP), gross capital formation, exports, and other trade-related variables to represent greenhouse gas (GHG) emissions.

Recent literature consistently reports that cryptocurrency mining, energy consumption, and fintech advancements have adverse effects on environmental quality (Dilek & Furuncu, 2019; Hileman & Rauchs, 2017; Krause & Tolaymat, 2018; Mora et al., 2018; O'Dwyer & Malone, 2014). However, it is important to highlight the positive correlation between fintech advancement and environmental well-being. The empirical model of this study examines the impact of fintech development on environmental quality, specifically focusing on the positive and negative effects. It aims to determine whether recent advancements in the fintech industry have resulted in net zero greenhouse gas (GHG) and carbon emissions. We present the conceptual framework as follows:

$$Emissions = f(Fintech\ Development) \quad (1)$$

Equation 1 can be simplified into a standard regression model by incorporating a country-level cross-sectional feature. This feature serves as a proxy for the dependent variable, as well as the independent and control variables. Hence:

$$Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_z X_z + \epsilon \quad (2)$$

Equation 2 represents the relationship between Y and greenhouse gas emissions (GHGE), which are measured as country-level data. In Equation 2, the variable X1 represents the level of fintech development (FINTD) for each country in the sample. The vector Xz represents a set of controlled macroeconomic variables, including exports (EXPO), gross capital formation (GCAPF), and gross domestic product (GDP). Table 1 displays the descriptive statistics indicating the presence of non-linearity in the data series. Therefore, it is necessary to transform the model into a log-linear or log-log specification in order to accurately represent the elasticities. The log-log specifications aid in understanding the extent to which the percentage change in GHGE is influenced by the percentage change in the independent variables, as suggested by prior research (Shahbaz et al., 2018). Finally, the model is specified as:

$$\log(GHGE_i) = \beta_0 + \beta_1 \log(FINTD_i) + \beta_2 \log(GDP_i) + \beta_3 \log(GCAPF_i) + \beta_4 \log(EXPO_i) + \epsilon_i \quad (3)$$

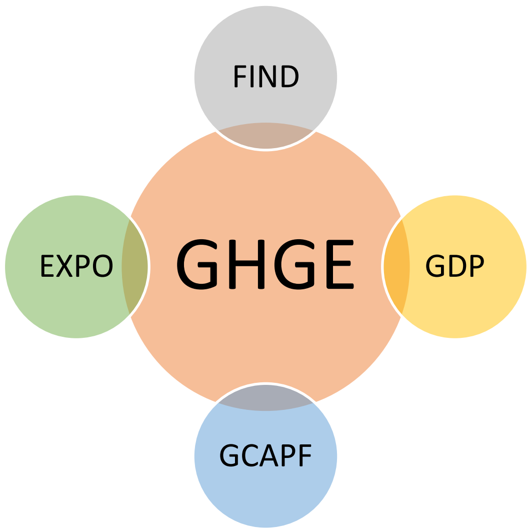

Figure 1: Conceptual Framework

3.1. Data Description

The study utilises various data sources. The GHGE variable is the dependent variable, and data at the country level is collected from the CAIT climate data explorer. The country-level data on fintech is sourced from the Global Fintech Index city ranking report (Findexable, 2019). The index was developed based on data and statistics from 2017, with a range of 0 to 100. In accordance with Jiao et al.'s (2021) research, we have chosen Asian countries based on their income levels. The World Development Indicators

(WDI) provide data on EXPO, GCAPF, and GDP, measured in US dollars as of 2017. This is done to address the variability in data caused by differences in price levels and GDP deflators across countries. Data was collected from 2017 to 2022.

Diagnostic Tests

The choice of a suitable model in a cross-sectional setting is contingent upon specific issues that must be addressed prior to estimation. The issues at hand are endogeneity and heteroscedasticity. Endogeneity bias, also known as omitted variable bias, arises from the exclusion of important variables and is an inherent characteristic of ordinary least squares (OLS) regression. This phenomenon is commonly referred to as "simultaneity bias," as it arises when the independent variables are dependent on the regressors. The Breusch-Pagan-Godfrey (BPG) test, proposed by Godfrey (1978, 1996) and Breusch and Pagan (1979), is used to identify heterogeneity. The null hypothesis for this test is the absence of heteroscedasticity, and it is conducted using a Lagrange multiplier test. Accepting the null hypothesis implies that heterogeneity is not a factor in the proposed model. Rejection of the null hypothesis would result in heteroscedasticity problems, which would compromise the reliability of the endogeneity test. Hence, research indicates that employing the generalised method of moments (GMM) estimator or the two-stage least squares (2SLS) model is recommended for addressing issues related to heterogeneity and endogeneity.

Table 1: Descriptive statistics of the variables.

	Bangladesh	**China**	**India**	**Indonesia**	**Japan**	**Malaysia**	**Pakistan**	**Philippines**	**Thailand**	**Vietnam**
					Population					
	164.6	1439.3	1380.0	273.5	126.4	32.3	220.8	109.5	97.33	69.79
					GHGE					
Mean	757.5516	102208.0	23124.4	5589.919	11932.8	2459.559	1860.881	1188.208	2828.558	2343.59
SD	125.9640	5693.709	2824.494	552.1543	893.0672	174.1940	280.4327	222.3971	93.21027	707.5708
					FINTD					
Mean	10.4	25.6	20.5	16.7	19.7	18.9	12.5	11	12.8	11.5
SD	2.217	2.52	1.342	2.677	12.157	3.231	1.32	3.401	1.662	3.709

The table also shows the population of the sample Asian countries over the period 2017 to 2022.

4. Empirical Results

4.1. Evaluation of Stylized Facts

Table 1 displays the mean and standard deviation values of GHGE and FINTD for the selected Asian countries in the sample. China and India exhibit high mean values for GHGE, indicating significant emissions of greenhouse gases. In contrast, the Philippines and Bangladesh demonstrate comparatively lower levels of emissions. China and India exhibit significant fintech development, while the Philippines and Bangladesh demonstrate limited progress in this area. This finding confirms a positive correlation between greenhouse gas emissions (GHGE) and financial technology development (FINTD). It suggests that as a country experience greater fintech development, there is a corresponding increase in GHG emissions. There appears to be a potential correlation between population size and GHGE across countries, except for Malaysia. Table 2 displays the correlation structure, indicating the degree of association between the variables. Correlation analysis offers an initial representation of the empirical associations between variables, aiding in the identification of the strength and direction of the hypothesised relationships. The correlation between GHGE and FINTD is of primary interest among the correlations presented in Table 3. There is a strong positive correlation between FINTD and GHGE, indicating that they both increase or decrease together.

The coefficients and p-values of both variables align with the results of previous studies conducted by Truby (2018) and DuPont (2019), which indicate that the excessive generation and consumption of electricity for financial technology contribute to environmental degradation. The relationship between GDP and GHG emissions is analogous to the environmental Kuznet curve (EKC). Countries frequently encounter the predicament of environmental degradation as a result of prioritising GDP growth. The correlation between exports by Asian countries and GHGE is positive, indicating that they tend to move in the same direction. This finding aligns with the results of a previous study by Wang et al. (2020), suggesting that this relationship may be attributed to the export of industrial products by the countries under investigation.

Table 2: Correlation matrix.

Correlation structure.	GHG	FTDI	GDP	GCF	EXP
GHGE	1.000				
FINTD	0.508**	1.000			
GDP	0.697***	0.630***	1.000		
GCAPF	0.592***	0.530	0.273	1.000	
EXPO	0.302*	0.473	− 0.376**	0.439	1.000

Note: Correlation among variables over the period 2017 to 2022. *** shows a level of confidence at 1%, while ** and * represent a level of confidence at 5% and 10%, respectively.

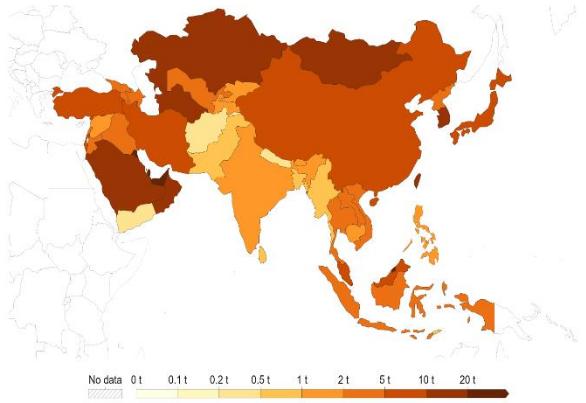

Figure 2: Per-capita carbon emissions to 2022. The emissions include emissions from gas, oil, coal, steel, cement, and other industries.
Source: Our World in Data based on Global Carbon Projects 2022.

Figure 3: Net zero emission targets of Asian countries. Blue shows countries that have achieved or pledged to achieve net zero emissions.
Source: Our World in Data, Net Zero Tracker. Energy & Intelligence Unit, Data-Driven EnviroLab. New Climate Institute, Oxford Net Zero.

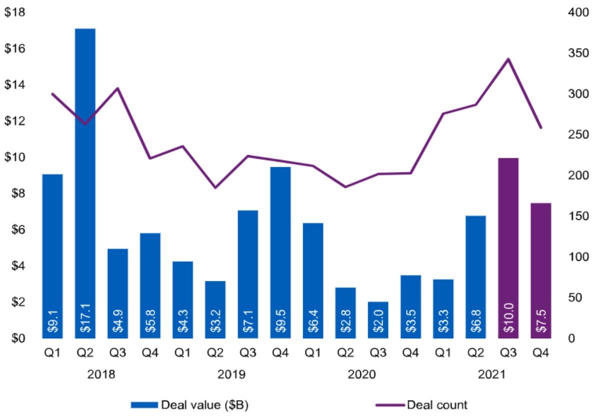

Figure 4: Total fintech investment in Asian region.
Source: Pulse of Fintech, Global Analysis of Investment in Fintech, KPMG International.

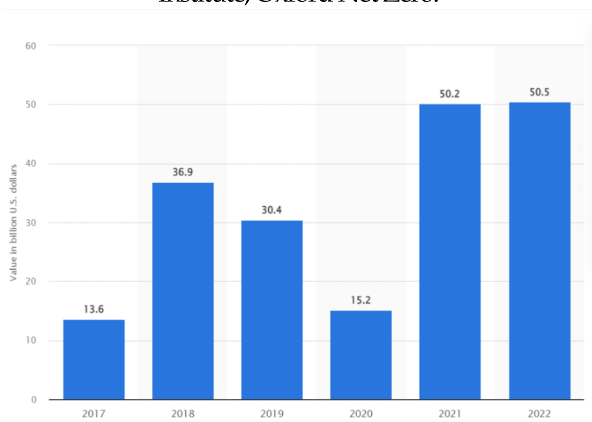

Figure 5: Value of fintech Investment in Asian region 2017-2022.
Source: Statista.com.

4.2. Estimates of Cross-sectional Regression

Table 4 displays the results of the regression analysis. The findings of Model 1 align with the anticipated outcomes derived from the evaluation of the stylized facts. There is a statistically significant positive relationship between FINTD and GHGE at a 5% level of significance. When control variables (GDP, GCAPF, and EXPO) are included individually in regression models 2 to 4, the relationship between FINTD and GHGE is reversed and becomes statistically significant and negative. Fintech advancements are found to have a mitigating effect on greenhouse gas emissions in Asian nations. When estimating the model coefficients in log-log form, we observe that a 1% reduction in greenhouse gas (GHG) emissions is linked to a 1% increase in fintech developments in Asian countries. Significant positive coefficients are observed between GDP and GHG emissions across models 2 to 4.

The results align with the majority of studies on the Environmental Kuznets Curve (EKC), which suggest that higher levels of GDP, economic advancement, and development contribute to environmental degradation. Table 3 demonstrates that the results for GCAPF are consistent with those for GDP. Significant findings are observed regarding exports from the sampled countries. There is a positive correlation between the increase in exports and greenhouse gas emissions (GHGE). Therefore, exports have a detrimental impact on environmental degradation. This is primarily due to the fact that countries engage in the exportation of industrial goods, which consequently leads to the emission of pollution throughout the production processes. The findings align with those of Wang et al. (2020). Existing research suggests that the fintech developments in a country may be affected by endogeneity issues. This is because the fintech development variable is endogenous and influenced by other factors such as income, wealth (GDP), trade openness, trade volume, capital formation, and investment in the country (Claessens et al., 2018; Pereira da Silva, Frost, & Gambacorta, 2019; Schindler, 2017).

Table 3: Outcomes of log-log model of emission of GHG.

Dep. Var:	Ln-GHGE (1)	Ln-GHGE (2)	Ln-GHGE (3)	Ln-GHGE (4)
α	4.528 (1.289) **	− 18.461 (1.708) ***	− 31.619 (2.027) ***	− 21.892 (2.343) ***
Ln-FINTD	1..829 (0.556) *	−1.781 (0.314) ***	− 1.001 (0.315) ***	− 1.091 (0.368) ***
Ln-GDP		2.332 (0.074) ***	2.0195 (0.075) ***	1.183 (0.095) ***
Ln-GCAPF			1.232 (0.433)	1.029 (0.443)
Ln-EXPO				0.652 (0.176) **
R-squared:	25.97383	20.70363	17.53033	12.90345
F-statistic:	12.772394	54.93744	36.73464	21.19023
Prob(F-stat):	0.00000	0.0000	0.0000	0.0000
Observations:	120	120	120	120

Note: *** shows a 1% level of confidence, while ** and * represent a level of confidence at 5% and 10%, respectively. The standard errors of the coefficients are reported in parentheses.

4.3. Robustness Test

To address the endogeneity concern, we employ two robustness tests, namely GMM and 2SLS, to validate the findings obtained from the OLS test. The presence of a significant negative relationship between FINTD and GHGE is supported by the results obtained from the Ordinary Least Squares (OLS), Two-Stage Least Squares (2SLS), and Generalised Method of Moments (GMM) analyses, as shown in Table 4. The findings presented in Tables 4 and 5 are inconsistent with the prevailing results reported in recent studies on environmental factors (Di̇lek & Furuncu, 2019; Hileman & Rauchs, 2017; Krause & Tolaymat, 2018; Mora et al., 2018; O'Dwyer & Malone, 2014). Truby (2018) and DuPont (2019) have indicated that the energy consumption associated with cryptocurrencies and fintech advancements contributes to the degradation of the climate.

The negative relationship between fintech advancements and GHG emissions aligns with previous research suggesting that technological innovations offer numerous solutions to improve environmental quality and mitigate its negative impacts (Gray, 1989; Simon & Kahn, 1984). The findings suggest the need to address climate-related challenges identified in recent studies (Dogan & Seker, 2016; Raghutla et al., 2021; Wang et al., 2021; Zeraibi et al., 2021). The findings support the perspective of fintech proponents, who argue that the advancement of financial technologies enhances environmental quality and provides solutions for climate-related issues (Nassiry, 2019; Puschmann et al., 2020).

Table 4: Outcomes of OLS, 2SLS and GMM.

Method: Dep. Var:	OLS Ln-GHGE	2SLS Ln-GHGE	GMM Ln-GHGE
α	− 18.328 (2.343) ***	− 17.986 (6.063) ***	− 32.488 (6.733) ***
Ln-FINTD	− 0.981 (0.368) ***	− 0.858 (0.204) ***	− 6.075 (1.805) ***
Ln-GDP	0.941 (0.095) ***	0.918 (0.381) **	1.876 (0.369) ***
Ln-GCAPF	0.709 (0.443)	0.741 (0.680)	− 0.597 (0.839)
Ln-EXPO	− 0.440 (0.1760) **	− 0.474 (0.577)	− 0.651 (0.175) ***
Observations:	120	120	120
R-squared:	45.192	53.761	60.622
F-statistic:	52.841	58.520	62.283
Prob(F-stat):	0.000	0.000	0.000

Note: The models are presented for robustness of GHG emissions and the explanatory variables. *** shows a level of confidence at 1%, while ** and * represent a level of confidence at 5% and 10%, respectively.

5. Conclusion and Recommendations

Over the past two decades, financial technologies have significantly transformed global financial ecosystems through enhanced competition, efficiency, and risk-sharing capabilities. As a result, the banking sector and financial institutions have experienced increased efficiency and competitiveness. Financial technologies have become the primary driver of capital markets, while the latest technological advancements also influence consumption and production patterns. Financial inclusion and the democratisation of technologies have positively impacted both local and international societies by enhancing experiences and facilities. In addition to the positive impacts of the fintech industry, the rapid growth of the financial sector leads to increased electricity consumption and generation of electronic waste, resulting in the depletion of natural resources. In light of growing concerns about environmental quality, policymakers and governments worldwide are grappling with the challenge of balancing technological innovation and development. While these advancements offer benefits in terms of efficiency and productivity, they also contribute to the degradation of environmental quality through the emission of air pollutants.

To achieve the dual goals of promoting fintech development and improving climate quality, it is crucial to implement an informed fintech policy that aligns with global environmental regulations. Policymakers are deeply concerned about the impact of fintech innovations and advancements. This study examines the relationship between fintech development and environmental quality in Asian countries aiming for a net-zero carbon economy, specifically focusing on the emission of greenhouse gases. We conducted an estimation of the results while considering the control variables of capital formation (GCAPF), exports (EXPO), and gross domestic product (GDP). By analysing the interrelationships, we have identified certain implications for governments and policymakers. Our analysis reveals a negative correlation between fintech advancements and greenhouse gas (GHG) emissions, while controlling for factors such as government carbon reduction policies (GCAPF), international expositions (EXPO), and gross domestic product (GDP).

Higher fintech developments result in reduced greenhouse gas (GHG) emissions and contribute to the enhancement of climate quality. Furthermore, we address endogeneity concerns by considering the interdependence between a country's fintech advancements and other explanatory variables, such as income and wealth (measured by GDP), trade openness, trade volume, capital formation, and investment. The findings consistently support the notion that fintech has a beneficial impact on environmental quality. This study offers recommendations for policymakers to enhance environmental quality through the promotion of an innovation-focused agenda and the development of financial technology (fintech). We propose that governments align technological policies with climate policies to address the negative environmental impact of fintech transactions and cryptocurrency mining. Additionally, it is suggested that the development policy for fintech be directed towards achieving the Sustainable Development Goals (SDGs).

Asian governments should offer substantial incentives to companies for investing in technology projects that promote sustainable environmental objectives. Governments ought to support research and development (R&D) in the fields of biotechnology and the advancement of environmentally friendly vehicles. Policymakers ought to encourage the utilisation of investment and research and development (R&D) tax credit programmes to facilitate the adoption of environmentally friendly technologies. Governments should support the advancement of fintech through the establishment of economic, legal, and physical infrastructure.

Fintech firms should develop portfolios comprising nanotechnologies, information technologies, and biotechnologies to improve environmental quality. Fintech startups must adhere to environmental quality policies. Governments should establish policies that promote environmentally friendly and secure advancements in fintech. Future research could analyse the same data from a global economic standpoint.

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