Energy Economics Letters
ISSN(e): 2308-2925
DOI: 10.55493/5049.v11i1.5027
Vol. 11, No. 1, 29-40.

URL: www.aessweb.com

Energy, economy, financial development, and ecological footprint in Singapore

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Article History
Received: 4 January 2024
Revised: 13 February 2024
Accepted: 1 March 2024
Published: 20 March 2024

Keywords
Climate change
Ecological footprint
Economic growth
Energy use
Financial development
Sustainable development.

JEL Classification:
C50; C58; O16; O44; P18; Q01; Q50; R11.

ABSTRACT

The escalating energy consumption resulting from rapid economic expansion is causing a decline in ecological health, therefore exacerbating the issue of climate change on a global scale. The juxtaposition of Singapore's ranking as having the most robust financial market with the largest ecological deficit globally implies the potential validity of the trade-off theory. The purpose of this study is to analyze the influence of Singapore's financial growth, energy use and economic development on the nation's ecological footprint. The investigation applied the Auto Regressive Distributed Lag (ARDL) method by using the annual time series data spanning from 1979 to 2021. The stationarity of data was confirmed by using several unit root tests. The ARDL bounds test revealed evidence for long term cointegration among the variables. The empirical results exposed that a 1% upsurge in financial growth, energy use, and economic expansion leads to a corresponding long-term increase in ecological footprint of 0.77%, 1.11% and 0.32%, as well as short-term increases of 0.44%, 0.61%, and 0.13%, respectively. Several diagnostic tests were used to confirm the accuracy of the ARDL outcomes. The findings of the analysis hold significant relevance for policymakers as they can inform the development of prudent policies that promote sustained economic prosperity without compromising environmental integrity.

Contribution/ Originality: This study investigates the energy-economy-environment nexus in light of financial development and ecological footprint in the context of Singapore.

1. INTRODUCTION

Climate change is widely recognized as a significant global challenge in the 21st century (Rajput, Singh, Singh, & Mall, 2023). It has garnered considerable attention from researchers, policymakers, and professionals affiliated with international organizations focused on sustainable development (Raihan et al., 2023). Given the aforementioned factors, it is evident that the preservation of the environment holds paramount importance for nations, particularly those that have ratified the Paris Agreement (Saud, Chen, & Haseeb, 2020). The emission of greenhouse gases (GHGs), leading to an increase in global temperatures (Yuan et al., 2023) and consequently disrupting ecological balance, is the primary and significant factor responsible for environmental degradation (Ahmed, Wang, Mahmood, Hafeez, & Ali, 2019). While carbon dioxide (CO_2) emissions are recognized as the primary contributor to GHG emissions and the underlying cause of climate change, human activities, play a significant role in this phenomenon. Specifically, the consumption of energy derived from fossil fuels, water waste management practices, deforestation activities, and fertilizer production are additional factors that contribute to the degradation of the ecosystem (Wang & Azam, 2024). Previous research utilized ecological footprints as a proxy for quantifying the impact of human activities on natural habitats (Khan, Yaseen, & Ali, 2019; Naqvi, Shah, & Mehdi, 2020; Saud et al., 2020; Uddin, Salahuddin, Alam, & Gow, 2017). The ecological footprint is a comprehensive assessment of the ecological burden imposed on the ecosystem due to human activities (Ahmed et al., 2019).

However, policymakers are today faced with a significant issue of finding a harmonious equilibrium between economic expansion and environmental preservation (Sun & Gao, 2023). Consequently, there is an emphasis on mitigating the adverse impacts that growth policies may have on the natural environment. Moreover, it should be noted that certain components essential for economic activity have the potential to adversely impact the environment, contingent upon specific contextual factors. Although there is evidence suggesting that the expansion of the finance market can have detrimental effects (Saud et al., 2020) there are also studies indicating that it may not be entirely detrimental (Uddin et al., 2017). However, it is important to note that there is a negative correlation between the finance market and environmental contamination. The finance industry has been identified as a significant source of pollution (Lan, Wei, Guo, Li, & Liu, 2023). A proficient financial system not only facilitates economic growth but also enables individuals to acquire assets such as residences, vehicles, and household appliances. However, this phenomenon exerts pressure on the environment because of its increased energy demand. Moreover, a shift in the economic landscape fosters investments in novel industrial facilities, consequently leading to a surge in water wastage and environmental pollution (Ahakwa, Xu, Tackie, & Mangudhla, 2023). However, it is widely acknowledged that economic expansion is associated with a reduction in pollution levels due to the allocation of resources towards research and development of environmentally sustainable technology and energy-efficient equipment (Ahmad, Youjin, Žiković, & Belyaeva, 2023). The government possesses a potent policy instrument to regulate the environmental burden, namely financial development. The organizations have the ability to leverage their influence over banking institutions in order to incentivize the provision of funding for production activities that exhibit reduced levels of pollution, so harnessing their authority. The financial industry has the potential to contribute to environmental conservation by implementing restrictions on loans for investment projects that have the potential to generate significant levels of pollution (Udeagha & Ngepah, 2023). Furthermore, the mitigation of environmental deterioration can be achieved by implementing mechanisms such as the provision of credit for initiatives that promote environmental sustainability, extending loans to socially responsible enterprises, and making investments in environmentally friendly projects (Saud et al., 2020).

Undoubtedly, the correlation between the expansion of the financial area and the state of the environment is intricately connected through several factors such as the technique, size, and components effects (Saud et al., 2020). In contrast, the findings of previous research on the correlation between the extension of the financial part and its impact on the environment exhibit conflicting outcomes. Contrarily, existing literature provides evidence that financial advancement yields adverse effects on the ecological footprint. This phenomenon was observed in many studies conducted by Furuoka (2015) in the context of Malaysia, Uddin et al. (2017) in a study including 27 nations, Destek and Sarkodie (2019) focusing on China, and Omoke, Nwani, Effiong, Evbuomwan, and Emenekwe (2020) examining Nigeria. In contrast, Godil, Sharif, Rafique, and Jermsittiparsert (2020) conducted a study on Turkey, Mrabet and Alsamara (2017) examined Qatar, and Usman, Kousar, and Makhdum (2020) investigated 20 affluent nations. All three studies found evidence supporting a positive link between financial growth and ecological footprint. The fast industrialization, economic expansion, and structural upheavals experienced by Singapore are subjects of great fascination (Raihan & Tuspekova, 2022). Notwithstanding its relatively small geographical size, the nation exhibits a significantly elevated population density, hence presenting a challenging predicament with respect to environmental degradation. Despite achieving significant economic growth goals, the Singaporean government expresses considerable apprehension regarding potential negative externalities, particularly the environmental consequences (Raihan et al., 2022). Despite the implementation of regulatory requirements by the Singaporean government and the findings of empirical studies that identify the factors contributing to environmental risks in Singapore, there is a growing call to manage ecological damage in a manner that does not compromise Singapore's economic growth (Quah & Tan, 2022). The aforementioned voices are advocating for a resolution that does not compromise the ongoing economic growth of Singapore. According to the data presented in Figure 1, Singapore exhibits an ecological footprint of around 6 global hectares per capita, a value that above the global average. Singapore is presently recognized as one of the nations with substantial ecological deficiencies, according to several countries. In recent times, Singapore has implemented a range of proactive initiatives aimed at addressing the ecological deficit situation, resulting in significant progress in the advancement of renewable energy technologies (Falcone, 2023). However, as per the International Energy Agency, Singapore has been ranked as the 27th most emissions-intensive country out of a total of 142, based on per capita emissions.

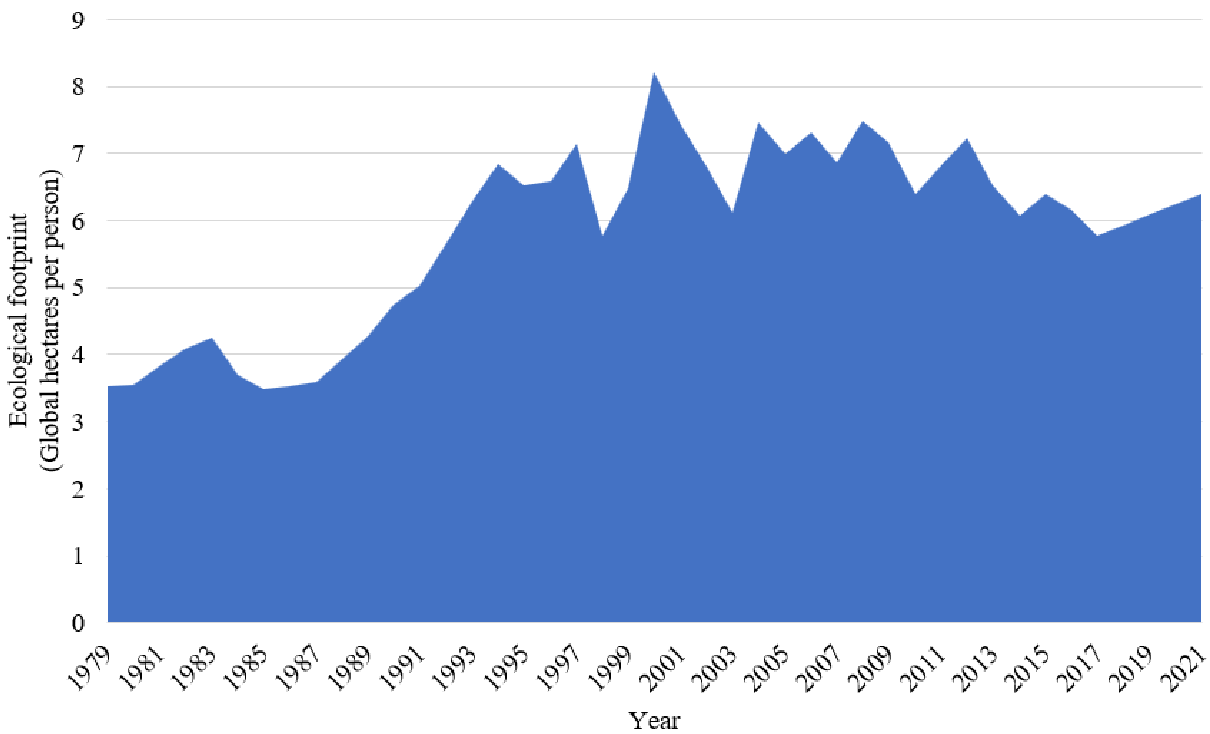

Figure 1. The yearly trend of ecological footprint in Singapore.

The existing body of literature on Singapore lacks consensus regarding the influence of the financial segment's growth on the environmental footprint. Destek and Sarkodie (2019) have reported that several studies have indicated a positive correlation between economic advance and an increase in the ecological footprint. Conversely, Naqvi et al. (2020) have found contrasting results in their own investigations, suggesting a negative link between economic progress and ecological footprint. The apparent contradictions in these outcomes have sparked a substantial discourse on the impact of Singapore's swift economic growth on its ecological footprint. The purpose of this research is to further investigate the effect of Singapore's financial growth and economic expansion on the country's ecological footprint. However, it is critical to note that the results of this inquiry diverge from the conclusions of previous studies in some aspects. Previous studies have examined the potential correlation between ecological factors and economic progression. However, these analyses did not include economic progress and energy use as a controlled variable. Moreover, the impact of Singapore's financial growth on the nation's ecological footprint has been found to have both positive (Destek & Sarkodie, 2019) negative (Naqvi et al., 2020; Saud et al., 2020) and insignificant (Khan et al., 2019) effects. These findings appear to be contradictory. Consequently, the present study used the ARDL methodology to assess the ramifications of Singapore's burgeoning economic growth, energy use, and financial expansion on the nation's ecological footprint. The present study's compelling results have the potential to provide policymakers in Singapore with novel perspectives on strategies for promoting sustainable development.

2. METHODOLOGY

2.1. Data and Empirical Model

The significance of monetary growth within the context of fiscal development is of great magnitude. However, it is undeniable that such growth may have detrimental effects on ecological systems. In a reciprocal manner, an increase in monetary expansion corresponds to a commensurate expansion in economic progress, which is directly proportional to the ecological impact. Therefore, in order to analyze the influence of monetary growth, energy use, and fiscal expansion on the environmental trajectory in the case of Singapore, this study has employed a specific model presented below:

$$EFt = \tau_0 + \tau_1 FD_t + \tau_2 GDP_t + \tau_3 EU_t + \varepsilon_t \quad (1)$$

Here, τ_1, τ_2, and τ_3 are the coefficients, whereas t is the interval spanning 1979 to 2021, and ε is the error term. The variable EF represents the ecological footprint, which is measured as the worldwide hectare per capita. This data was obtained from the worldwide Footprint Network. The FD parameter represents the level of financial development, specifically measured as the domestic credit stipulated to the private sector as a ratio of the Gross Domestic Product (GDP). On the other hand, the GDP variable refers to the per capita GDP, which is computed using constant Singapore Dollars and EU is the energy use per capita (kg of oil equivalent). The data pertaining to financial expansion, energy use, and GDP were collected from the World Bank. The variables were utilized by using a logarithmic function in order to enhance the clarity of the data. Equation 2 presents the econometric model for investigating the influence of finance, economy, and energy on Singapore's ecological footprint.

$$LEFt = \tau_0 + \tau_1 LFD_t + \tau_2 LGDP_t + \tau_3 LEU_t + \varepsilon_t \quad (2)$$

2.2. Stationarity Check

This study first looks at the dependent variable's interactions with its explanatory components to find out the dataset's integration order (1). Further, not all regressors require a seasonal impact or inclusion at order one. Besides, trying to avoid the I(2) sequence is wrong and could lead to misleading results. Also, the results could be skewed if nonstationary factors are present. However, the sample size is small, which is a cause for concern, and the shift to I(2) is unprecedented. The Augmented Dickey-Fuller (ADF), Dickey-Fuller generalized least squares (DF-GLS), and Phillips-Perron (P-P) unit root tests are used to determine if there are any I(2) variables in this inquiry.

2.3. ARDL Approach

Pesaran, Shin, and Smith (2001) ARDL limits examining approach of cointegration was used to look at the ongoing connection across the variables. This cointegration test has several benefits over conventional methods in terms of the integration sequence. One can use this methodology if the factors are found to be stationary at the integrated of order 1 (I(1)) or integrated of order 0 (I(0)) level, or at the mixed integrated of order 1 and order 0 (I(1)/I(0)) level. The ARDL bounds investigating observed model describes the data generation process efficiently by using a general-to-specific analysis framework and incorporating an appropriate number of lags. The ARDL F-statistic, a measure indicating the presence of factor cointegration, can be computed inside the ARDL framework. The lags for each parameter are modified and tested in this test. The elements being studied are considered cointegrated if the ARDL model's F-statistic is greater than a predetermined upper critical value. The lack of cointegration across the variables is indicated when the ARDL model's F-statistic is less than the lower critical bound. There is insufficient information to draw compelling conclusions when the ARDL F-statistic value is between the upper and lower critical levels. In order to investigate cointegration, the following Equation 3 depicts the estimated structure for the ARDL limits analysis method.

$$\Delta LEF_t = \tau_0 + \tau_1 LEF_{t-1} + \tau_2 LFD_{t-1} + \tau_3 LGDP_{t-1} + \tau_4 LEU_{t-1} + \sum_{i=1}^{q} \gamma_1 \Delta LEF_{t-i} + \sum_{i=1}^{q} \gamma_2 \Delta LFD_{t-i} + \sum_{i=1}^{q} \gamma_3 \Delta LGDP_{t-i} + \sum_{i=1}^{q} \gamma_4 \Delta LEU_{t-i} + \varepsilon_t \quad (3)$$

Where Δ is first difference operator and q is the lag length.

The ARDL bounds assessment approach can be linearly changed in order to derive the error correction model (ECM). The methodology employed in this study produces reliable empirical findings even when working with small sample sizes. In order to maintain the overall perspective over an extended period, the ECM effectively incorporates the immediate intricacies alongside the enduring stability. The proposed approach aims to identify and isolate the cointegrating trajectories that arise from the empirical model due to the existence of several cointegrating vectors. The symbol θ represents the coefficient of the ECM. The range of the ECM is typically constrained between 0 and 1, with values below 0 being extremely rare and values above 1 being nonexistent. When encountering situations where the anticipated coefficient of the ECM is both negative and statistically significant, it becomes imperative to address the issue of variance correction in order to achieve equilibrium. The short-term coefficients of the parameters were calculated in this study by employing Equation 4 subsequent to determining the long-term link between the series.

$$\Delta LEF_t = \tau_0 + \tau_1 LEF_{t-1} + \tau_2 LFD_{t-1} + \tau_3 LGDP_{t-1} + \sum_{i=1}^{q} \gamma_1 \Delta LEF_{t-i} + \sum_{i=1}^{q} \gamma_2 \Delta LFD_{t-i} + \sum_{i=1}^{q} \gamma_3 \Delta LGDP_{t-i} + \sum_{i=1}^{q} \gamma_4 \Delta LEU_{t-i} + \theta ECM_{t-1} + \varepsilon_t \quad (4)$$

3. RESULTS AND DISCUSSION

Table 1 displays the descriptive statistics. It can say with confidence that all parameter median and mean estimates are quite close to one another based on the data that has been collected and assessed. As can be seen by the skewness numbers approaching zero, the kurtosis values falling below 3, and the Jarque-Bera test values remaining under their respective criteria, all of the study's data follow a normal distribution.

Table 1. Descriptive statistics.

Variables	LEF	LFD	LGDP	LEU
Mean	1.73	4.55	10.7	8.59
Median	1.83	4.55	10.7	8.58
Maximum	2.10	4.90	11.4	8.92
Minimum	1.24	4.16	9.77	8.23
Skewness	-0.15	0.16	-0.33	0.27
Kurtosis	2.13	2.12	1.91	2.01
Jarque-Bera	1.43	1.55	1.89	1.76
Probability	0.65	0.45	0.23	0.25

The initial stage involves ensuring that order one, denoted as I(1), encompasses the entirety of the dataset, particularly the response parameters. This is achieved by the examination of the degree of correlation between the outcome variables and predicted factors

Table 2. The unit root analysis results.

Variables	ADF		DF-GLS		P-P	
	Log levels	Log first difference	Log levels	Log first difference	Log levels	Log first difference
Ecological footprint	-1.86	-6.59***	-0.93	-6.67***	-1.83	-6.65***
Financial development	-1.32	-6.23***	-0.07	-5.73***	-1.42	-6.23***
Economic growth	-1.83	-6.01***	-1.43	-4.65***	-1.83	-6.02***
Energy use	-1.89	-6.32***	-1.23	-5.98***	-1.67	-6.36***

Note: *** denotes significance at 1% level.

. Furthermore, it is deemed inappropriate to incorporate all regressors of first order or to exhibit transient unit roots. Both of these methodologies have inherent limitations. The ADF, DF-GLS, and P-P three-unit root tests were utilized to assess the order of the variables and verify their adherence to the precondition. The findings of the unit root analyses are displayed in Table 2. The findings revealed that all of the metrics investigated exhibit stationarity at the initial difference. The data are therefore suitable for the ARDL estimator.

Resulting in the confirmation of the dependability of the unit roots of the variable, this study focused on conducting an ARDL limits test to examine the character of the long-term relationship between the factors. Table 3 presents the empirical conclusions derived from the utilization of ARDL limits analyzing methodologies for cointegration analysis. The empirical data provided strong support for the poise of long-term cointegration among the factors in issue, as indicated by the anticipated F-statistic above the upper critical bound values.

Table 3. ARDL bounds test results.

F-bounds test		Null hypothesis: No degrees of relationship		
Test statistic	**Estimate**	**Significance**	**I(0)**	**I(1)**
F-statistic	6.17	At 10%	2.63	3.35
K	3	At 5%	3.10	3.87
-	-	At 2.5%	3.55	4.38
-	-	At 1%	4.13	5.00

After establishing a durable link, this analysis will continue to approximate both the long-term and short-term factors. The findings of both the long- and short-run experiments are presented in Table 4. The results obtained by the ARDL estimation demonstrate that there is a positive and statistically significant relationship between financial expansion and ecological footprint, both in the short and long run. A marginal increase of 1% in economic advancement is followed by a subsequent rise of 0.32% in ecological footprint over the long term and 0.13% in the near term, under the assumption of constant GDP. Constructed on the research findings, it is suggested that the implementation of Singapore's financial deepening policy could potentially have adverse implications on the country's environmental quality. The present finding aligns with the research conducted by Destek and Sarkodie (2019) which revealed that economic advancement positively influences the ecological footprint in Singapore. Though, this study's conclusions are in contrast to the findings of Saud et al. (2020) which implied that financial deepening has a tendency to reduce the ecological footprint in Singapore.

Table 4. ARDL long and short term results.

Variables	Long-run			Short-run		
	Coefficient	**t-statistic**	**p-value**	**Coefficient**	**t-statistic**	**p-value**
LGDP	0.77***	6.49	0.00	0.44***	4.06	0.00
LFD	0.32***	3.88	0.00	0.13***	3.72	0.00
LEU	1.11***	5.24	0.00	0.61***	4.28	0.00
C	7.37	2.58	0.13	-	-	-
ECM (-1)	-	-	-	-0.54***	-3.18	0.00
R^2	0.97	-	-	-	-	-
Adjusted R^2	0.96	-	-	-	-	-

Note: *** denotes significance at 1% level.

Grounded on the conclusions of the analysis, it can be incidental that the phenomenon of scale effect in Singapore can be ascribed to the facilitation of financial expansion, which in turn promotes economic liberalization and attracts foreign direct investment. The verdicts advocate that the advancement of Singapore's financial sector is associated with a corresponding growth in economic development, heightened levels of output, and increased energy consumption, particularly in relation to the usage of fossil fuels, which may be attributed to Singapore's trading activities (Destek & Sarkodie, 2019). The current dispute aligns with the outcomes of recent analyses carried out in ASEAN countries, such as Singapore, which have extensively utilized fossil fuels across several industries (Nathaniel & Khan, 2020). Consequently, the expansion of the economy yields two inadvertent outcomes: firstly, an escalation in greenhouse gas emissions, along with the concomitant pollution of air and soil; and secondly, a general augmentation in the environmental footprint (Saud et al., 2020). Therefore, it is imperative for the Singaporean administration to implement substantial enhancements to the existing policies concerning the extension of the financial segment.

Based on the findings of the ARDL model, it is evident that economic expansion exerts a statistically significant and beneficial influence on the ecological footprint, both in the short-term and the long-term. To provide more clarification, an expansion of 1% in economic growth leads to a resultant growth of 0.44% in the ecological footprint in the short-term, and 0.77% in the long-term. The results of the ARDL scrutiny indicate that heightened levels of economic activity have a positive sway on the ecological footprint. The upward trend in economic growth has led to a corresponding rise in electricity consumption (Nathaniel & Khan, 2020) promotion of urban development through incentives, and increased strain on infrastructure and ecological resources. These outcomes align with the trade-off hypothesis and statistical evidence that demonstrates a relationship between economic advancement and environmental impact (Sharma, Sinha, & Kautish, 2020). The scale impact hypothesis offers empirical evidence to substantiate the notion that heightened economic activity has the potential to disrupt the intricate equilibrium within global biodiversity, hence resulting in an expanded ecological footprint. As previously stated, the escalation of economic development has led to a notable surge in the combustion of fossil fuels inside ASEAN countries, including Singapore. Therefore, it is imperative to implement more effective measures for economic advancement in order to maintain the state of the environment.

This study centers on the excessive energy consumption and environmental deterioration in Singapore. The expected energy use coefficients are positively and significantly significant at the 1% level, suggesting that a 1% rise in energy consumption in Singapore leads to a long-run increase of 1.11% and a short-run increase of 0.61% in ecological footprint. The findings of this study align with the research conducted by Raihan and Tuspekova (2022) as well as Raihan et al. (2022) in Singapore. Previous research have established a strong correlation between energy consumption and ecological footprint, indicating that many countries heavily depend on coal, natural gas, and oil, leading to increased environmental degradation. The findings of the current study indicate a deterioration in Singapore's environmental quality due to an increase in energy demand. However, a significant 86% of Singapore's primary energy is derived from petroleum and other liquid sources, while 13% is obtained from natural gas. Hence, implementing a renewable energy infrastructure capable of substituting fossil fuels is the paramount policy. The implementation of renewable energy sources is vital to guarantee sustainable growth and alleviate the adverse impacts of climate change. Renewable energy enhances economic growth and reduces carbon emissions (Madaleno & Nogueira, 2023). It is environmentally sustainable, and other advantages include enhanced energy accessibility and energy stability (Chen, Umar, Su, & Mirza, 2023). In light of the increasing worldwide awareness of the environment, Singapore needs to transition to renewable energy sources in order to facilitate the utilization of environmentally sustainable energy and the establishment of an ecologically friendly ecosystem. Singapore's primary energy requirement is comprised of less than 1% renewable energy. Singapore requires a thorough renewable energy policy in order to shift towards a low-carbon economy.

At the 1% level of significance, the investigation of ECM in this study produces a significant negative outcome. The size and sign of the estimated ECM can be used to determine the speed at which a system moves from an instance of short-run disequilibrium to long-run equilibrium. This discovery shows that when short-term mistakes are fixed by 54%, long-term equilibrium is achieved. Furthermore, the long-run evaluation yielded R2 values of 0.97 and 0.96, indicating that the proposed regression model fits the data quite well. This finding emphasizes that the independent variables explain around 96% of the variation in the dependent variable.

The empirical estimates of different diagnostic statistics are displayed in Table 5. To ensure that the residuals follow a normal distribution, one can use the Jarque-Bera test. The serial correlation problem was investigated using the Lagrange multiplier (LM) approach. In the absence of a model, the LM test results show that a serial correlation problem exists. The forecast model used the Breusch-Pagan-Godfrey technique to check for heteroscedasticity. The computed model does not display heteroscedasticity, according to the Breusch-Pagan-Godfrey analysis. Applying the Ramsey reset test proved that the model was well-founded.

Table 5. Diagnostic test results.

Diagnostic probes	Coefficient	p-value	Decision
Jarque-Bera analysis	2.92	0.23	The residuals have a normal distribution
Breusch-Godfrey LM analysis	0.90	0.41	There is no serial correlation
Breusch-Pagan-Godfrey analysis	0.91	0.45	There is no heteroscedasticity
Ramsey RESET analysis	0.42	0.75	The model is precisely described

In order to assess the model's structural stability, this study employed the CUSUM and CUSUMSQ functions Figure 2. One way to find out how stable the model parameters are is to look at how far the scatter plots are from the critical bound; a divergence of no more than 5% is considered acceptable. Throughout the examination, the CUSUM and CUSUMSQ values stayed within the allowed range of +/- 5%, as seen in the graphs.

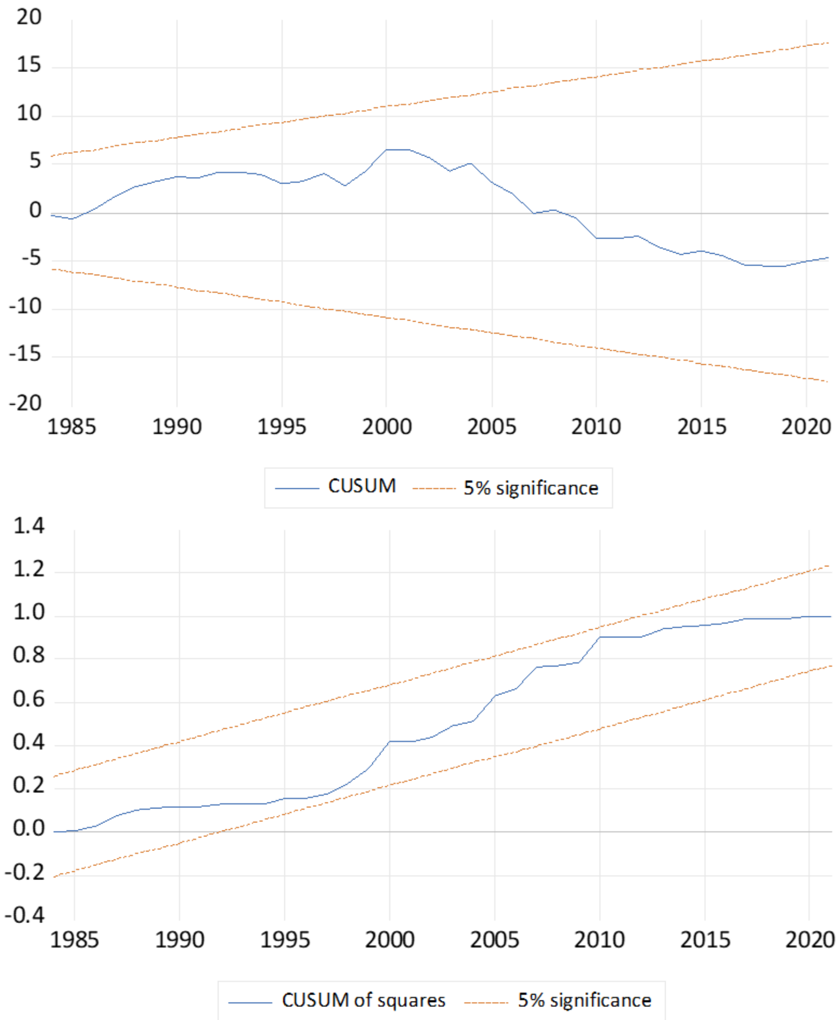

Figure 2. The CUSUM and CUSUMQ plots.

4. CONCLUSIONS AND POLICY IMPLICATIONS

This research aimed to determine the true nature of the liaison between economic growth, energy use, financial development and ecological footprint in Singapore. The research employed the ARDL methodology to yield informative outcomes in pursuit of the stated objective. In order to establish the integration sequence of the data, this research employed ADF, DF-GLS, and P-P unit root tests. The study revealed the presence of long-term cointegration amid the parameters by the utilization of the ARDL bounds test. The results indicate that a 1% upsurge in financial growth, energy use, and economic expansion will advance to a corresponding long-term increase in ecological footprint of 0.77%, 1.11%, and 0.32%, as well as short-term increases of 0.44%, 0.61%, and 0.13%. The available evidence suggests that the trade-off theory, which posits a relationship between economic development and natural assets, appears to be applicable in the case of Singapore. In order to achieve the goals of sustained economic growth in Singapore, it is imperative to enhance the efficacy of monetary expansion policies.

The analysis suggests that economic development policies in Singapore should prioritize the consistent reduction of fossil fuels and the maintenance of a balance between urbanization and the preservation of ecological resources. The reason for this phenomenon is that the economic expansion in Singapore contributes to the augmentation of the country's ecological imprint. Consequently, it is imperative to promote the exploitation of renewable resources while concurrently diminishing dependence on non-renewable alternatives. The desired outcome can be attained by the implementation of environmental levies and the provision of financial incentives to promote the advancement of pollution-reducing technologies.

The data unequivocally demonstrate that the current financial policy measures implemented in Singapore have the potential to jeopardize the environmental quality. There is a need for greater integration and enhanced efficiency in incorporating the nation's involvement in policy tools aimed at promoting the development of the financial sector. In order to effectively promote environmental quality, it is imperative to establish a seamless connection between the policies of economic advancement and financial development within the Singaporean framework. In order to enhance clarity, it is recommended that economic development allocate a larger proportion of its resources headed for the investigation, advancement, and adoption of technology that is more environmentally sustainable and promotes cleanliness. Through the facilitation of research and development, along with advancements in technology, economic advancement has the potential to positively impact the state of the environment.

Novel technology acts a vital position in the elimination of outdated and inefficient technologies, while also fostering the development of innovative and advanced solutions in the realms of production and daily life. Hence, it is imperative for the Singaporean government to prioritize the pivotal role played by the financial sector in providing resources for the adoption of environmentally sustainable technologies in both newly established enterprises and existing businesses, as a substitute for obsolete technologies. Furthermore, the research indicates that it would be beneficial for the Singaporean government to promote the optimal utilization of resources by enhancing financial collaboration for initiatives that are ecologically conscious, all the while ensuring a favorable interest rate. In summary, it is imperative to allocate increased financial resources to facilitate the promotion of environmental regulations and enhance environmental awareness among local communities.

The report proposes the utilization of additional renewable or clean energy sources to enhance the performance of Singapore's energy consumption structure and to reduce the ecological footprint. Given the constrained space available for renewable energy production, the vast majority of Singapore's energy supply is obtained through imports. Singapore has the capacity to fulfill its entire need for renewable energy due to the ample availability of solar energy. Singapore is considering allocating funds towards innovation, research, and test beds in order to enhance the efficiency of solar power systems and investigate innovative methods of integrating them into urban environments. Singapore may analyze power networks in the region and develop low-carbon solutions such as the exploitation of low-carbon hydrogen and the implementation of carbon capture and storage. These efforts aim to enhance energy security and investigate potential new energy sources. Singapore is continuously conducting research on novel energy sources to enhance energy diversity and ensure security. This would contribute to nationwide initiatives aimed at ensuring consistent electricity accessibility. Singapore aims to persist in nuclear energy research and establish the requisite capabilities for comprehending nuclear science and technology, notwithstanding the potential obsolescence of certain technologies such as nuclear power. Singapore has the potential to improve its energy education initiatives. Tax incentives, economic subsidies, and government purchases can promote the adoption of more environmentally friendly energy usage. It is possible that the government may seek the help of the media to promote "low-carbon behaviors and consumption patterns" and the concept of a "green lifestyle."

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The author states that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Data Availability Statement: Data regarding energy use, economic growth, and financial development are available at the World Development Indicators database (https://databank.worldbank.org/source/world-development-indicators). The data on ecological footprint is available at the Global Footprint Network (https://data.footprintnetwork.org/?_ga=2.10334005.1842153785.1698692440-375885211.1698692439#/countryTrends?cn=216&type=BCpc,EFCpc).
Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.

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