Akademik Araştırmalar ve Çalışmalar Dergisi 2024, 16(31), 429-440
Journal of Academic Researches and Studies 2024, 16(31), 429-440
https://doi.org/10.20990/kilisiibfakademik.1512603

Makale Türü: Araştırma Makalesi
Paper Type: Research Paper

Geliş Tarihi/Received Date: 08.07.2024
Kabul Tarihi/Accepted Date: 09.10.2024

Investigation of Pollution Haven Hypothesis for China: A Fourier ADL Cointegration Analysis

Çin için Kirlilik Cenneti Hipotezinin Araştırılması: Bir Fourier ADL Eşbütünleşme Analizi

Ayşegül HAN[1], Gökhan KONAT[2], Mehmet Ali POLAT[3]

Abstract

Purpose: This study tests the Pollution Paradise Hypothesis by examining the role of FDI and economic growth on China's load factor over the period 1979-2021. The main objective of this study is to assess the environmental impact of FDI and economic growth in China.

Design/Methodology: Various econometric analyses have been carried out to examine FDI, economic growth indicators and the freight capacity factor. In this context, conventional ADF and Fourier ADF unit root tests were applied to the freight capacity factor, FDI and economic growth series and then to the shocks to these series.

Findings: In conclusion, it is emphasised that in order to achieve sustainable development goals in China, policy makers should adopt more effective environmental sustainability policies, taking into account the impact on FDI and economic growth.

Limitations: It tests the Pollution Paradise hypothesis by examining the role of FDI and economic growth on the load factor in China. The research is therefore specific to China.

Originality/Value: This study aims to contribute to the literature by assessing the environmental impact of FDI in China in a more holistic way, and from a perspective that has not been analysed before.

Keywords: Pollution Paradise Hypothesis, Load Capacity Factor, Foreign Direct Investment, Economic Growth, Sustainable Development.

Öz

Amaç: Bu araştırma, 1979-2021 döneminde Çin'de Doğrudan yabancı yatırımlar ve ekonomik büyümenin yük kapasitesi faktörü üzerindeki rolünü araştırarak Kirlilik Cenneti Hipotezini test etmektedir. Bu çalışmanın temel amacı, Çin'deki doğrudan yabancı yatırımların ve ekonomik büyümenin çevresel etkilerini değerlendirmektir.

Tasarım/Yöntem: Doğrudan yabancı yatırımlar, ekonomik büyüme göstergeleri ve yük kapasite faktörünü araştırmak için çeşitli ekonometrik analizler yapılmıştır. Bu bağlamda, geleneksel ADF ve Fourier ADF birim kök testleri yük kapasite faktörü, Doğrudan yabancı yatırımlar ve ekonomik büyüme serilerine ve ardından bu serilerin şoklarına uygulanmıştır.

Bulgular: Sonuç olarak, Çin'de sürdürülebilir kalkınma hedeflerine ulaşmak için politika yapıcıların doğrudan yabancı yatırımlar ve ekonomik büyüme üzerindeki etkileri dikkate alarak çevresel sürdürülebilirlik konusunda daha etkin politikalar benimsemeleri gerektiği vurgulanmaktadır.

Sınırlılıklar: Çin'de Doğrudan yabancı yatırımlar ve ekonomik büyümenin yük kapasitesi faktörü üzerindeki rolünü araştırarak Kirlilik Cenneti Hipotezini test etmektedir. Dolayısıyla, araştırma Çin özelinde yapılmıştır.

Özgünlük/Değer: Bu çalışma, özellikle Çin'deki doğrudan yabancı yatırımların çevresel etkilerini daha bütüncül bir şekilde değerlendirerek ve daha önce incelenmemiş bir perspektiften yaklaşarak literatüre katkıda bulunmaktadır.

Anahtar Kelimeler: Kirlilik Cenneti Hipotezi, Yük Kapasite Faktörü, Doğrudan Yabancı Yatırım, Ekonomik Büyüme, Sürdürülebilir Kalkınma

[1] Dr., İnönü Üniversitesi, aysegullhann@gmail.com, ORCID: 0000-0002-3390-2129
[2] Doç. Dr., Bolu Abant İzzet Baysal Üniversitesi, İ.İ.B.F., Ekonometri, gokhan.konat@inonu.edu.tr, ORCID: 0000-0002-0964-7893
[3] Doç. Dr., Bursa Uludağ Üniversitesi, İ.İ.B.F., İktisat, mmpol01062011@gmail.com, ORCID: 0000-0001-9239-8228

1. INTRODUCTION

Economic growth, access to energy and action against climate change, which are the main components of the sustainable development goal of the United Nations (UN) organization, are the priority areas of the sustainable development phenomenon. However, the movement of direct foreign investments from developed countries to developing countries for reasons such as less stringent environmental laws, cheap labor, and natural resources has begun to put pressure on climate change targets. Direct foreign investments towards developing countries, although they lead to information dissemination, increased institutional quality and economic growth also bring environmental degradation (Long et al., 2015).

New literature examining the relationship between foreign direct investments and environmental pollution suggests that foreign direct investments are directed to developing economies due to additional costs arising from environmental regulations, and therefore environmental pollution may increase. When the literature on the issue is evaluated, two main hypotheses explain the influence of foreign direct investments on environmental contamination. These are the Pollution Halo Hypotheses and the Pollution Haven Hypotheses. According to The Pollution Paradise Hypothesis, foreign direct investments can transfer technology from less developed countries to more developed countries (Hoffmann, 2005). Thanks to this transfer, countries that use higher technology have better management practices and can produce less carbon emissions (Shahbaz et al., 2011). Therefore, The Pollution Paradise Hypothesis argues that the investments of multinational companies reduce pollution by encouraging the use of green and energy-efficient technologies (Bergh and Nijkamp, 1994; Shahbaz et al., 2011). In other words, foreign direct investments can contribute positively to environmental protection with advanced technologies and environmentally friendly practices. The Pollution Paradise Hypothesis suggests that strict environmental policies in developed economies create a competitive advantage for polluting industries that move to less developed regions (Hoffmann et al., 2005; Acharyya, 2009; Blanco et al., 2013; Caglar, 2020; Singhania and Saini, 2021). According to this hypothesis, MNCs invest in regions that offer low costs and labour advantages, leading to an increase in pollution. A positive interaction between FDI and carbon emissions is suggested by The Pollution Paradise Hypothesis. In other words, this hypothesis suggests that as the level of foreign direct investment increases, so does the level of interaction between countries and carbon emissions. This is explained by abandoning environmental standards and taxes to produce more at lower cost and attract more foreign investors (Kirkulak et al., 2011; Blanco et al., 2013). Many studies have confirmed the pollution halo and pollution haven hypotheses using different samples and analytical methods (He, 2006; Hoffmann et al., 2005; Kirkulak et al., 2011; Lau et al., 2014; Zeren, 2015; Mert and Çağlar, 2020).

Several studies (Sullivan et al., 2010; Akın, 2014; Paramati et al., 2017; Zhao and Yang, 2020; Adebayo et al., 2021) have examined the impact of various economic and social determinants on carbon emissions. Akinsola et al. (2022) argue that carbon emissions are not sufficient to be a full representation of the overall environmental degradation. Galli et al. (2012) emphasised ecological footprints as comprehensive ecological variables to assess environmental degradation. The idea of the ecological footprint, proposed by Rees (1992) as an ecological accounting criterion, also includes the area required for infrastructure and plants that absorb waste carbon dioxide. Ecological footprint calculations measure the demand side of nature in global hectares, while biocapacity measures the supply side of nature. The concept aims to determine how long humans can continue to take from nature and leave waste in return. In this way we can learn about the extent of the natural resources that are still available, and solutions can be developed to prevent the constant consumption of nature.

Studies have also been conducted on the impact of social and economic factors on the ecological footprints of developed or developing countries (Figge et al., 2017; Shahbaz et al., 2017; Akadiri et al., 2019; Danish et al., 2020; Ozbek and Naimoğlu, 2022). However, the supply side of ecosystems has been neglected in these studies. They generally focus on the ecological footprint. At this point, Siche et al. (2010), who are looking for a more accurate measurement for environmental assessments, proposed an indicator they called the “load capacity factor." The load capacity factor expresses the power of a country to keep its people living contemporary lifestyles. The load capacity

factor is calculated by dividing the ecological footprint by the biocapacity. If this factor is less than 1, it indicates that the ecosystem is not sustainable, while if it is greater than 1, it indicates that the ecosystem is sustainable. (Pata, 2021). According to Siche et al. (2010), indicators that solely consider supply and demand, like ecological footprint and biocapacity, are unable to accurately represent and replicate environmental degradation. For this reason, the load capacity factor is suggested as a more thorough environmental assessment metric. The load capacity factor provides a more meaningful criterion for assessing the sustainability of the environmental situation, suggesting that the threshold of sustainability is 1.

In previous literature, studies focusing on the assessment of environmental impacts were often limited to specific indicators such as carbon emissions or ecological footprints. The main motivation for carrying out the study is the use of new indicators, such as the load capacity factor, that have been ignored or not adequately addressed in the existing literature, thus allowing a more comprehensive understanding of environmental impacts. In particular, this study aims to contribute to the literature by evaluating the environmental impacts of foreign direct investments in China more holistically, approaching them from a previously unexamined perspective. It is expected that the evaluations made within the framework of the load capacity factor will provide a more comprehensive perspective in terms of environmental sustainability and contribute to the literature.

Assessing the environmental impact of FDI and economic growth in China is the main objective of this study. In particular, using a new indicator, the carrying capacity factor, the study aims to test the Pollution Paradise Hypothesis. By using this factor, which is generally ignored in the existing literature, the study aims to provide a more comprehensive understanding of the impact of FDI and economic growth on environmental sustainability. The general purpose and motivation of the research are expressed in the introduction of this study. Then, in the literature review section, it is examined how the existing studies deal with the impact of foreign direct investment and economic growth on environmental impacts, and the gaps in the field are highlighted. Next, the data set and methodology section describes the basic analytical framework of the study and the data collection methods used. The findings section presents the results of the analysis and a discussion of the literature. The conclusion summarises the main findings of the study and highlights how they contribute to the overall purpose. It also identifies limitations and provides suggestions for future research.

2. LITERATURE REVIEW

There are two groups of literature that examine the relationship between FDI and low-carbon economic development: Pollution Haven and Pollution Halo hypotheses. Developed by Walter and Ugelow (1969) and tested by Baumol and Oates (1988), the Pollution Paradise Hypothesis suggests that FDI increases domestic carbon emissions by relocating polluting industries. This hypothesis argues that pollution-intensive industries will move from countries where environmental costs are high to countries where they are low. Countries with lower environmental standards will therefore become a 'haven' for pollution-intensive industries. The Pollution Paradise Hypothesis is based on the perspective that FDI is focused on improving the local environment, as put forward by Birdsall and Wheeler (1993). This hypothesis suggests that FDI leads to resource and factor input savings and environmental improvements through technology diffusion by bringing in advanced equipment and pioneering technology.

Khalil and Inam (2006), one of the studies that defended the Fossil Fuel Paradise Hypothesis-that FDI increases carbon emissions-confirmed that FDI was positively related to CO2 emissions in Pakistan between 1972 and 2002. Acharkyya (2009) concluded that FDI in India during the period 1980 to 2003 increased India's carbon emissions. Zhao et al. (2013) confirmed the Pollution Paradise Hypothesis and concluded that China has become a pollution haven for high carbon industries that have been transferred from the United States.

Xie et al. (2011) show empirically that FDI inflows in China reduce carbon emissions. This is one of the studies that argue for the Pollution Paradise Hypothesis, which states that FDI reduces carbon emissions in the host country rather than contributing to them. Xu and Deng (2012) showed that the spatial clustering of FDI in China has an ameliorative effect on environmental pollution in China. Nie and Hai-yu (2015) show that foreign firms entering China between 2003 and 2001 had a

pollution halo effect, with cities with lower environmental standards attracting more polluting foreign firms to enter. Yu and Xu (2019) found that foreign direct investment in China improved CO2 emissions between 2000 and 2017.

Some studies in the literature emphasize that foreign direct investments have a dual effect, with their potential to promote economic development and employment as well as their negative effects, such as environmental pollution and damage. Among these studies, Lee (2013) finds that foreign direct investment played an important role in economic growth in the G20 countries between 1971 and 2009, and that economic growth limited the increase in CO2 emissions. A dynamic relationship between CO2 emissions, energy consumption, economic growth and foreign direct investment in Vietnam over the period 1980-2010 was concluded by Linh and Lin (2014). Balibey (2015) finds strong causality among foreign direct investment, economic growth and CO2 emissions in Turkey between 1974 and 2011. As a result of their study examining the relationship between CO2 emissions, energy consumption, foreign direct investments, and economic growth in Vietnam, Tang and Tan (2015) obtained results that support the Environmental Kuznet Curve hypothesis. Sapkota and Bastola (2017) show that there is a positive relationship between foreign direct investment and environmental pollution in 14 Latin American countries over the period 1980 to 2010. Yilmaz et al. (2017) concluded that foreign direct investments in BRICS and MINT countries moved together with economic growth and carbon dioxide emissions in the 1997–2013 period. In this context, the strategy of maintaining a healthy balance between foreign direct investments and environmental protection emerges as an important research topic. In particular, based on the pollution haven and pollution halo hypotheses (Behera and Dash, 2017; Liu et al., 2019; Caglar, 2020), the relationship between foreign direct investment and environmental pollution should be analysed in more detail.

In particular, this study offers a more detailed analysis of the impact of environmental pollution on economic growth, expanding the relevant perspective that is limited in the existing literature. Additionally, this study contributes to the more holistic health of degradation by using the load capacity factor to make residual violence impact assessments more comprehensive, often with specific indicators such as carbon emissions and ecological footprints in the literature. In this context, the study aims to reveal a broader perspective on improvability by offering a different perspective from the literature on evaluating the effects of relationships.

3. ECONOMETRIC ANALYSIS

3.1. Data Set and Methodology

According to the purpose of the study, the current research examines the role of foreign direct investment and economic growth on China's load factor from 1979 to 2021. The model under consideration in the study is the following:

$$LCF_t = \beta_0 + \beta_1 FDI_t + \beta_2 GDP_t + e_t$$

where "LCF" represents the load capacity factor calculated by dividing the ecological footprint by biocapacity, "FDI" represents foreign direct investments, and "GDP" represents economic growth. Within this study's scope, analyses were carried out by taking the logarithm of the economic growth variable. β_0 denotes the constant term, and e_t denotes the error term. Table 1 provides detailed information about the variables taken into account in the empirical model:

Table 1: Variables and Their Sources

Indicator	Variable	Resource
LCF	Load Capacity Factor	Global Footprint Network
FDI	Foreign Direct Investments	World Bank
GDP	Economic Growth	World Bank

The descriptive statistics and correlation matrix for the variables are stated in Table 2.

Table 2: Descriptive Statistics and Correlations

Descriptive Statistics			
	LCF	FDI	GDP
Mean	0.403	2.516	28.682
Median	0.412	2.564	28.690
Maximum	0.635	6.187	30.424
Minimum	0.221	0.000	26.695
Std. Dev.	0.145	1.722	1.175
Skewness	0.134	0.234	-0.106
Kurtosis	1.554	1.964	1.730
Jarque-Bera	3.965	2.368	3.039
Probability	0.138	0.306	0.219
Correlation Matrix			
	LCF	FDI	GDP
LCF	1		
FDI	-0.468 (0.000)	1	
GDP	-0.966 (0.000)	0.473 (0.000)	1

The skewness and kurtosis values reveal variations in the distributions of the variables under examination, even if the mean and median values of the load capacity factor are near one another when analyzed using the descriptive statistics shown in Table 2. While negative skewness in the economic growth variable indicates that the distribution is pulled to the left, a high kurtosis value indicates that the peak of the distribution is steeper than normal. In the foreign direct investment variable, there is a lower skewness and kurtosis value, which shows that the distribution is closer to a normal distribution.

In terms of the correlation matrix, the negative correlation between the capacity utilisation rate and foreign direct investment shows that increases in the capacity utilisation rate have a negative effect on foreign direct investment. Furthermore, the very strong negative correlation between the capacity utilisation rate and economic growth indicates that increases in the capacity utilisation rate have a negative effect on economic growth. The positive correlation between FDI and economic growth indicates that increasing FDI helps economic growth.

3.2. Fourier ADF Unit Root Test

As a unit root test that facilitates the estimation of structural changes, Enders and Lee (2012) propose the Fourier ADF (FADF) unit root test. The data-generating procedure for this test is as follows:

$$y_t = c + \rho y_{t-1} + \gamma t + \varepsilon_t$$

$\alpha(t)$ represents the deterministic component and ε_t represents the error term. $\alpha(t)$ is modeled as follows:

$$\alpha(t) = \alpha_0 + \sum_{k=1}^{n} \alpha_k sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{n} \beta_k cos\left(\frac{2\pi kt}{T}\right)$$

$$n \leq \frac{T}{2}$$

where n represents frequencies, k represents a specific frequency, and T represents observed data. Traditional unit root tests are used when Fourier terms are meaningless. In other words, traditional ADF unit root test results provide strong results in cases where Fourier terms are meaningless.

3.3. Fourier ADL Hidden Cointegration Test

Granger and Yoon (2002), who examined the relationships in which variables can react differently to different shocks as well as reacting to the same shocks, argued that shocks should be examined by separating them into negative and positive components. Granger and Yoon (2002)

introduced the idea of latent cointegration to the literature in this regard. Banerjee et al. (2017) incorporated Fourier elements into the autoregressive distributed lag (ADL) cointegration model to prevent anomalous outcomes while examining cointegration connections, leading to the invention of the Fourier ADL (FADL) cointegration test.

Yılancı et al. (2019) proposed a new test proposal by combining FADL and the latent cointegration test. This test obtains strong results by separating the variables into negative and positive shocks and applying the shock-specific FADL cointegration test. In this research, the long-term relationships between foreign direct investments, economic growth, and load capacity factors were examined with the asymmetric FADL model proposed by Yılancı et al. (2019). In this context, the following FADL model was created for the model to be examined.

$$\Delta ykf_t = \alpha_0 + \alpha_1 sin\left(\frac{2\pi kt}{T}\right) + \alpha_2 cos\left(\frac{2\pi kt}{T}\right) + \alpha_4 ykf_{t-1} + \alpha_5 dyy_{t-1} + \alpha_6 lngdp_{t-1} + \alpha_7 \Delta ykf_{t-1} + \alpha_8 \Delta dyy_{t-1} + \alpha_9 \Delta lngdp_{t-1}$$

where k, t and T indicate the specific frequency, trend, and number of observations, respectively. When determining the value of k, the model is estimated for $1 < k < 5$, and the frequency in the model with the smallest Akaike information criterion (AIC) is accepted as the appropriate k. Then, the basic hypothesis ($H_0: \alpha_4 = 0$) is tested with the following test statistic:

$$t_{ADL}^{F} = \frac{\hat{\alpha}_4}{se(\hat{\alpha}_4)}$$

Critical values are found in the Banerjee et al. (2017) study. The model investigated here was estimated separately for both negative and positive components.

3.4. Findings

Several econometric analyses were carried out in this study to assess the environmental impact of FDI and economic growth, and to examine their impact on the load factor, in order to test the Pollution Paradise Hypothesis for China. The normal values and then the shocks of the load factor, FDI and economic growth series were subjected to unit root tests. Accordingly, the first step was to analyse the stationarity of the series. The traditional ADF and Fourier ADF unit root tests were used. The results are presented in Table 3. The distributed lag The Fourier ADL cointegration test was then used to analyze the cointegrated connection between the normal series and the series divided into positive and negative components. Coefficient estimation was carried out for variables separated into shocks that were seen to be in equilibrium in the long run. The results are presented in Table 4 and Table 5, respectively.

Table 3: FADF Unit Root Test Results

Variables	*k*	min. KKT	F Stat. Value	*l*	FADF	ADF
LCF	2	0.018	0.008	13	-3.25	-2.189
ΔLCF	2	0.018	0.11	12	2.857	-8.304***
FDI	1	23.201	20.843***	6	-0.795	
ΔFDI	4	26.038	20.779***	4	-12.572***	
GDP	1	13.101	5.286**	2	-1.749	
ΔGDP	1	12.091	6.188**	1	5.818***	
$LCF^{(+)}$	2	20.113	17.226***	1	1.145	
$\Delta LCF^{(+)}$	2	16.101	28.127***	1	-4.01***	
$FDI^{(+)}$	2	14.169	18.058***	1	-0.228	
$\Delta FDI^{(+)}$	4	15.061	34.887***	1	-5.322***	
$GDP^{(+)}$	1	18.075	19.659***	2	-0.909	
$\Delta GDP^{(+)}$	1	0.067	28.300***	1	-5.990***	
$LCF^{(-)}$	2	11.014	16.829***	1	-0.156	
$\Delta LCF^{(-)}$	4	23.014	14.235***	1	-5.294***	
$FDI^{(-)}$	4	43.732	35.148***	1	1.900	
$\Delta FDI^{(-)}$	4	57.358	54.150***	1	-5.066***	
$GDP^{(-)}$	5	18.005	17.703***	8	-1.486	
$\Delta GDP^{(-)}$	5	27.004	29.317***	8	-8.486***	

Note: ***p<0.01, **p<0.05; *p<0.10. Critical values for the F statistic are from Becker et al. (2016); Critical values for the Fourier ADF unit root test are included in the study of Enders and Lee (2012). l indicates the appropriate delay length and k indicates the appropriate number of frequencies.

Stationarity properties have been assessed for both the normal series and the positive and negative components of the variables according to the unit root test in Table 3. The Fourier functions of the GDP and FDI variables, except for the LCF variable, are significant according to the F-test results in the normal series examined. The traditional ADF unit root test was carried out for the LCF series, where the Fourier function was not significant. The series was found to be difference stationary, i.e. I(1). As a result of the FADF test, the FDI and GDP series, where the Fourier functions are significant, are found to be I(1). In the shock separated series, the Fourier functions of the positive and negative components of all variables examined are significant according to the F-test results. The FADF unit root test results, examined after having found the significance of the Fourier functions, also show that the positive and negative components of all variables become stationary at the first difference.

After determining that the series are difference-stationary, FADL cointegration results, which are applied to determine the long-term relationship for both the normal values of the variables and the values separated into positive and negative components of the variables, are presented in Table 4.

Table 4: FADL Cointegration Results

	Frequency	AIC	Test Stat. Value	Result
$[LCF_t = f(FDI_t, GDP_t)]$	2	-5.453	-2.556	No cointegration
$[LCF_t = f(FDI_t, GDP_t)]^{(+)}$	1	-3.361	-4.668*	There is cointegration
$[LCF_t = f(FDI_t, GDP_t)]^{(-)}$	2	-5.667	-4.603**	There is cointegration

Note: ***p<0.01, **p<0.05; *p<0.10. Critical values are included in Banerjee (2017) study.

A long-term association between the load capacity factor, foreign direct investments, and economic growth in both positive and negative shocks was discovered when the results of the Fourier ADL cointegration analysis were analyzed. However, no long-term relationship was identified in the normal series.

Table 5: FMOLS Long-Term Coefficient Estimation Results

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
$[YKF_t = f(DYY_t, LNGDP_t)]^{(+)}$	$FDI^{(+)}$	0.0001	0.0187	0.0061	0.9952
	$GDP^{(+)}$	0.7167	0.0606	11.8216	0.0000***
	Sin	-0.1642	0.0374	-4.3871	0.0001***
	Cos	0.3283	0.0269	12.1935	0.0000***
	Constant Term	-0.8557	0.1098	-7.7935	0.0000***
$[YKF_t = f(DYY_t, LNGDP_t)]^{(-)}$	$FDI^{(-)}$	0.0561	0.0131	4.2798	0.0001***
	$GDP^{(-)}$	-0.0444	0.0399	-1.1136	0.2724
	Sin	-0.3936	0.0832	-4.7295	0.0000***
	Cos	0.2745	0.0435	6.3070	0.0000***
	Constant Term	-0.2228	0.0704	-3.1655	0.0030***

Note: ***p<0.01, **p<0.05; *p<0.10.

Table 5 shows that the positive shocks of foreign direct investment and the negative shocks of economic growth are not statistically significant. However, it was found that the positive shocks of economic growth and the negative shocks of foreign direct investments were statistically significant and affected the load capacity factor positively. In addition, a 1% increase in the positive shocks of economic growth in the long term will create a 0.72 increase in the load capacity factor. A one-unit increase in the negative shocks of foreign direct investments indicates that there will be a 0.06 increase in the load capacity factor. It is also concluded that trigonometric terms are statistically significant in both positive and negative shocks. These results suggest that the increase in the load capacity factor due to positive growth implies enhanced sustainability. Therefore, the positive and statistically significant impact of economic growth on the load capacity factor can be interpreted as an indication that economic growth promotes sustainability, as it contributes to a more efficient use of resources.

The theoretical framework supporting the validity of the Pollution Paradise Hypothesis is reflected in the observed long-term relationship between load factor, FDI and economic growth in

China. The Pollution Paradise Hypothesis is the theory that foreign investment can be a source of environmental degradation, as foreign investment is directed to regions with lower environmental standards. In this context, a dynamic whereby pollution-intensive industries are attracted to regions with lower environmental costs may be reflected in the long-run relationship between the load factor and FDI. The results of the cointegration analysis show that FDI moves in tandem with economic growth, suggesting that this relationship is not limited to environmental impacts, but that economic growth also influences this process. Therefore, the theory that environmental impacts can combine with foreign investment and economic growth to create a pollution paradise effect is strongly supported by this long-term relationship observed in China.

These results are consistent with those found in other existing studies. The theoretical expectations regarding the environmental impact of foreign investment are supported by the fact that the long-run relationship between the freight capacity factor, FDI and economic growth in China is consistent with the Pollution Paradise Hypothesis. In this regard, the results of the cointegration analysis, which are consistent with the findings of Khalil and Inam (2006), Acharkyya (2009), and Zhao et al. (2013), strengthen the possibility that the Pollution Paradise Hypothesis, which suggests that foreign investment may increase environmental pollution by directing it to regions with low environmental standards, is valid in China. However, the results of the studies supporting the Pollution Paradise Hypothesis are inconsistent. While Xie et al. (2011) show that FDI inflows reduce carbon emissions, Xu and Deng (2012) and Nie and Hai-yu (2015) suggest that foreign firms may create a pollution halo effect by attracting cities with lower environmental standards. Yu and Xu (2019), on the other hand, point to a perspective that supports the Pollution Paradise Hypothesis by showing that FDI leads to improvements in CO2 emissions in China. These conflicting findings highlight the complexity of the dynamics between environmental impacts, foreign investment and economic growth. They suggest that future research should focus on a deeper understanding of these relationships. In addition, these results suggest that policy makers should adopt a more careful strategy on how to channel foreign investment in order to achieve the goals of environmental sustainability.

4. CONCLUSION

It can be said that China is a haven for FDI, both in terms of cheap labour and inadequate environmental regulation. While FDI is a positive development for the country's economy, it is also a negative development for environmental quality. China's carbon emissions have been on a steady rise since the 1960s, especially since the 2000s. Foreign direct investment (FDI) has flowed into China for reasons such as looser environmental restrictions compared to developed countries and the availability of cheap labour. In this context, there has been a significant increase in carbon dioxide emissions as a result of China's rapid industrialisation. This study tested the Pollution Paradise Hypothesis using a new environmental assessment indicator, the load capacity factor, to assess the environmental impact of FDI and economic growth in China. The study aimed to provide a more comprehensive understanding of the impact of FDI and economic growth on environmental sustainability by using the load capacity factor, which has not been considered in the existing literature. To this end, the role of foreign direct investment and economic growth on the load capacity factor was examined. Relevant data from China were used for the period 1979-2021. According to the results of the Fourier ADL cointegration analysis, an asymmetric cointegrated relationship was obtained between the positive and negative components of the variables considered within the scope of the Pollution Paradise Hypothesis. In other words, a long-term relationship has been identified between shocks. Long-run coefficient estimation was carried out for the variables separated into shocks that were seen to be in equilibrium in the long run. In the long run, a 1% unit increase in the positive shocks of economic growth will create a 0.72 increase in the load capacity factor. A one-unit increase in the negative shocks of foreign direct investments indicates that there will be a 0.06 increase in the load capacity factor. Therefore, it was concluded that the Pollution Paradise Hypothesis is valid for China.

The Chinese economy has experienced great economic growth in recent years and has become an important actor in the world. In this process, factors such as the increase in foreign direct investments directed at the Chinese economy, the adoption of new technologies, increasing production capacity, and expanding employment contributed greatly to growth. Economic growth in China is generally associated with high natural resource consumption along with industrialization and

urbanization processes. The fact that investments in China both support economic growth and contribute to the goal of environmental sustainability and more efficient use of natural resources may have created a positive long-term relationship between the load capacity factor and FDI. In addition, the fact that China's economic policies include a long-term sustainability goal may have led to increased investments in energy efficiency, the use of renewable energy, and environmental protection. This may support the adoption of an economic growth model that takes into account the load capacity factor. As a result, the positive long-term relationship between the load capacity factor and foreign direct investments and economic growth in China is due to the impact of efforts and policies towards sustainable development goals.

Although they have a natural cost, such as environmental pollution, direct investments are very important for the country's economy. In this context, it can be wondered whether some developing countries consciously keep environmental restrictions loose. This type of policy may cause environmental problems in the long run. Today, China, which is considered the world's foreign investment base and has become the world's second superpower thanks to its increasing production, may not consciously take environmental restrictions into account. However, to make this growth sustainable, loose environmental restrictions must be ended. Ultimately, every policy has a cost.

Etik Beyan: *Bu çalışmada "Etik Kurul" izini alınmasını gerektiren bir yöntem kullanılmamıştır.*
Yazar Katkı Beyanı*:1. Yazarın katkı oranı %50, 2. yazarın katkı oranı %30, 3. yazarın katkı oranı %20'dir.*
Çıkar Beyanı*: Yazarlar arasında çıkar çatışması yoktur.*

Ethics Statement: *In this study, no method requiring the permission of the "Ethics Committee" was used.*
Author Contributions Statement*: 1st author's contribution rate is 50%, 2nd author's contribution rate is 30%, 3rd author's contribution rate is 20%.*
Conflict of Interest**:** *There is no conflict of interest among the authors.*

REFERENCES

Acharyya, J. (2009). FDI, Growth and the Environment: Evidence from India on CO2 Emission During the Last Two Decades. *Journal of Development Economics, 34*(1), 43-58. Doi: 10.35866/caujed.2009.34.1.003.

Adebayo, T. S., Akinsola, G. D., Odugbesan, J. A., and Olanrewaju, V. O. (2021). Determinants of Environmental Degradation in Thailand: Empirical Evidence from ARDL and Wavelet Coherence Approaches. Pollution, 7(1), 181-196. doi: 10.22059/poll.2020.309083.885.

Akadiri, S. S., Alkawfi, M. M., Uğural, S., and Akadiri, A. C. (2019). Towards Achieving Environmental Sustainability Target in Italy. The Role of Energy, Real Income and Globalization. *Science of the Total Environment,* 671, 1293-1301. https://doi.org/10.1016/j.scitotenv.2019.03.448.

Akın, C. S. (2014). Yabancı Sermaye Yatırımlarının CO2 Emisyonu Üzerine Olan Etkisi: Dinamik Panel Veri Analizi, *Akademik Bakış Uluslararası Hakemli Sosyal Bilimler Dergisi,* 44.

Akinsola, G.D., Awosusi, A. A., Kirikkaleli, D., Umarbeyli, S., Adeshola, I. and Adebayo, T. S. (2022). Ecological Footprint, Public Private Partnership Investment in Energy, and Financial Development in Brazil: A Gradual Shift Causality Approach. *Environmental Science and Pollution Research,* 29, 10077-10090. https://doi.org/10.1007/s11356-021-15791-5.

Balıbey, M. (2015). Relationships among CO2 Emissions, Economic Growth and Foreign Direct Investment and the Environmental Kuznets Curve Hypothesis in Turkey, *International Journal of Energy Economics and Policy, 5*(4), 1042-1049.

Banerjee, P., Arcabic, V., and Lee, H. (2017). Fourier ADL Cointegration test to Approximate Smooth Breaks with New Evidence from Crude Oil Market. *Economic Modelling*, 67, 114-124. https://doi.org/10.1016/j.econmod.2016.11.004.

Behera, S. R., and Dash, D. P. (2017). The Effect of Urbanization, Energy Consumption, and Foreign Direct Investment on the Carbon Dioxide Emission in the SSEA (South and Southeast Asian) Region. *Renewable and Sustainable Energy Reviews,* 70, 96-106. https://doi.org/10.1016/j.rser.2016.11.201.

Bergh, J., and Nijkamp, P. (1994). Dynamic Macro Modelling and Materials Balance: Economic-Environmental Integration for Sustainable Development. *Economic Modellingi 11*(3), 283-307. https://doi.org/10.1016/0264-9993(94)90006-X.

Birdsall, N., and Wheeler, D. (1993). Trade Policy and Industrial Pollution in Latin America: Where are the Pollution Havens? *The Journal of Environment and Development, 2*(1), 137-149. https://doi.org/10.1177/107049659300200107.

Blanco, L., Gonzalez, F., and Ruiz, I. (2013). The Impact of FDI on CO2 Emissions in Latin America. *Oxford Development Studies, 41*(1), 104–121. https://doi.org/10.1007/s11069-023-05949-4.

Baumol, W., and Oates, W. (1988). *The Theory of Environmental Policy*, 2nd ed. Cambridge: Cambridge University Press.

Caglar, A. E. (2020). The Importance of Renewable Energy Consumption and FDI Inflows in Reducing Environmental Degradation: Bootstrap ARDL Bound test in Selected 9 Countries. *Journal of Cleaner Production,* 264, 121663. https://doi.org/10.1016/j.jclepro.2020.121663.

Danish, Ulucak, R., Khan, S.U.-D. (2020). Determinants of the Ecological Footprint: Role of Renewable Energy, Natural Resources, and Urbanization. *Sustainable Cities and Society,* 54, 101996. https://doi.org/10.1016/j.scs.2019.101996.

Enders, W., and Lee, J. (2012). The Flexible Fourier form and Dickey-Fuller Type Unit Root Tests. *Economics Letters*, *117*(1), 196-199. https://doi.org/10.1016/j.econlet.2012.04.081.

Figge, L., Oebeles, K., and Offermans, A. (2017). The Effects of Globalization on Ecological Footprints: An Emprical Analysis. *Environment, Development and Sustainability, 19*(3), 863-876. https://doi.org/10.1007/s10668-016-9769-8.

Galli, A., Wiedmann, T., Ercin, E., Knoblauch, D., Ewing, B. and Giljum, S. (2012). Integrating Ecological, Carbon and Water Footprint into a "Footprint Family" of Indicators: Definition and Role in Tracking Human Pressure on the Planet. *Ecological Indicators*, *16*, 100-112. https://doi.org/10.1016/j.ecolind.2011.06.017.

Granger, C.W. ve Yoon, G. (2002), Hidden cointegration, University of California, Department of Economics, *Working Paper.* San Diego: University of California. http://dx.doi.org/10.2139/ssrn.313831.

He, J. (2006). Pollution Haven Hypothesis and Environmental Impacts of Foreign Direct Investment: The Case of Industrial Emission of Sulfur Dioxide (SO2) in Chinese Provinces. *Ecological Economics, 60*(1), 228–245. https://doi.org/10.1016/j.ecolecon.2005.12.008.

Hoffmann, R., Lee, C. G., Ramasamy, B., and Yeung, M. (2005). FDI and Pollution: A Granger Causality Test Using Panel Data. *Journal of International Development, 17*(3), 311-317. http://dx.doi.org/10.1002/jid.1196.

Khalil, S. and Inam, Z. (2006). Is Trade Good for Environment? A Unit Root Cointegration Analysis. *The Pakistan Development Review, 45*(4):1187-1196. https://doi.org/10.30541/v45i4IIpp.1187-1196.

Kirkulak, B., Qui, B., and Yin, W. (2011). The Impact of FDI on Air Quality: Evidence from China, *Journal of Chinese Economic and Foreign Trade Studies, 4*(2), 81-98. https://doi.org/10.1108/17544401111143436.

Lau, L. S., Choong, C. K., and Eng, Y. K. (2014). Investigation of the Environmental Kuznets Curve for Carbon Emissions in Malaysia: Do Foreign Direct Investment and Trade Matter? *Energy Policy,* 68, 490-497. https://doi.org/10.1016/j.enpol.2014.01.002.

Lee, J. W. (2013). The Contribution of Foreign Direct Investment to Clean Energy Use, Carbon Emissions and Economic Growth. *Energy Policy,* 55, 483-489. https://doi.org/10.1016/j.enpol.2012.12.039.

Linh, D. H., and Lin, S. (2014). CO2 Emissions, Energy Consumption, Economic Growth and FDI in Vietnam. *Managing Global Transitions, 12*(3), 219-232.

Liu, J., Qu, J., and Zhao, K. (2019). Is China's Development Conforms to the Environmental Kuznets Curve Hypothesis and the Pollution Haven Hypothesis? *Journal of Cleaner Production,* 234, 787–796. https://doi.org/10.1016/j.jclepro.2019.06.234.

Long, C, Yang, J, and Zhang, J. (2015). Institutional Impact of Foreign Direct Investment in China. *World Development,* 66, 31-48. https://doi.org/10.1016/j.worlddev.2014.08.001.

Mert, M., and Çağlar, A. E. (2020). Testing Pollution Haven and Pollution Halo Hypotheses for Turkey: A New Perspective. *Environmental Science and Pollution Research, 27*(26), 32933-32943. https://doi.org/10.1007/s11356-020-09469-7.

Nie, F., and Hai-yu, L. I. U. (2015). Correlation Analysis of FDI, Environmental Pollution and Economic Growth: An Empirical Examination Based on Dynamic Simultaneous Equation Model. *Journal of International Trade,* 2, 72–83. https://doi.org/10.13510/j.cnki.jit.2015.02.008.

Osei, M. J., and Kim, J. (2020). Foreign Direct Investment and Economic Growth: Is More Financial Development Better? *Economic Modelling,* 93, 154-161. https://doi.org/10.1016/j.econmod.2020.07.009.

Özbek, S., and Naimoğlu, M. (2022). Çevre Kalitesi-Ekonomik Karmaşıklık Ilişkisi: Türkiye Ekonomisi Üzerine Fourier Eşbütünleşme Analizi. *İstanbul İktisat Dergisi, 72*(1), 407-431. https://doi.org/10.26650/ISTJECON2022-1061837.

Paramati, S. R., Mo, D., and Gupta, R. (2017). The Effects of Stock Market Growth and Renewable Energy Use on CO2 Emissions: Evidence from G20 Countries, *Energy Economics,* 66, 360-371. https://doi.org/10.1016/j.eneco.2017.06.025.

Paul, J., and Feliciano-Cestero, M. M. (2021). Five Decades of Research on Foreign Direct Investment by MNEs: An Overview and Research Agenda. *Journal of Business Research*, *124*, 800–812. https://doi.org/10.1016/j.jbusres.2020.04.017.

Pata, U. K. (2021). Renewable and Non-renewable Energy Consumption, Economic Complexity, CO2 Emissions, and Ecological Footprint in the USA: Testing the EKC Hypothesis with a Structural Break. *Environmental Science and Pollution Research International*, *28*(1), 846–861. https://doi.org/10.1007/s11356-020-10446-3.

Rees, W. E. (1992) Ecological Footprint and Appropriated Carrying Capacity: What Urban Economics Leaves out. *Environment and Urbanization,* 4, 121-130. http://dx.doi.org/10.1177/095624789200400212.

Sapkota, P., and Bastola, U. (2017). Foreign Direct Investment, Income, and Environmental Pollution in Developing Countries: Panel Data Analysis of Latin America. *Energy Economics,* 64, 206–212. https://doi.org/10.1016/j.eneco.2017.04.001.

Shahbaz, M., Nasreen, S., and Afza, T. (2011). Environmental Consequences of Economic Growth and Foreign Direct Investment: Evidence from Panel Data Analysis, *MPRA Paper,* University Library of Munich, Germany.

Shahbaz, M., Nasreen, S., Ahmed, K., and Hammoudeh, S. (2017). Trade Openness–Carbon Emissions Nexus: The Importance of Turning Points of Trade Openness for Country Panels. *Energy Economics,* 61, 221–232. https://doi.org/10.1016/j.eneco.2016.11.008.

Siche, R., Pereira, L., Agostinho, F., and Ortega, E. (2010). Convergence of Ecological Footprint and Emergy Analysis as a Sustainability Indicator of Countries: Peru as Case Study.

Communications in Nonlinear Science and Numerical Simulation, 15(10), 3182–3192. https://doi.org/10.1016/j.cnsns.2009.10.027.

Singhania, M., and Saini, N. (2021). Demystifying Pollution Haven Hypothesis: Role of FDI. Journal of Business Research, 123, 516-528. https://doi.org/10.1016/j.jbusres.2020.10.007.

Sullivan, J. L., Burnham, A., and Wang, M. (2010). Energy-Consumption and Carbon-Emission Analysis of Vehicle and Component Manufacturing, Argonne National Lab., Argonne, United States. https://doi.org/10.2172/993394.

Tang, C. F. , and Tan, B. W. (2015). The Impact of Energy Consumption, Income and Foreign Direct Investment on Carbon Dioxide Emissions in Vietnam. *Energy,* 79, 447-454. https://doi.org/10.1016/j.energy.2014.11.033.

Walter, I., and Ugelow, J. L. (1969). Environmental Policies in Developing Countries. AMBIO, 8(2-3), 102-109.

Xu, H., and Deng, Y. (2012). Does Foreign Direct Investment Cause Environmental Pollution in China-Spatial Metrology Research Based on China's Inter Provincial Panel Data. *Management World,* 2, 30-43. https://doi.org/10.19744/j.cnki.11-1235/f.2012.02.004.

Yılancı, V., Ozgur, O., and Gorus, M., S. (2019). The Asymmetric Effect of Foreign Direct Investment on Clean Energy Consumption in BRICS Countries: A Recently Introduced Hidden Cointegration Test. *Journal of Cleaner Production*, 237, 1-9. https://doi.org/10.1016/j.jclepro.2019.117786.

Yılmaz, T., Zeren, F., and Koyun, Y. (2017). Doğrudan Yabancı Yatırımlar, Ekonomik Büyüme ve Karbondioksit Emisyonu İlişkisi: BRICS ve MINT Ülkeleri Üzerinde Ekonometrik Bir Uygulama, *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi,* 22, 1235-1254.

Yu, Y., and Xu, W. (2019). Impact of FDI and R&D on China's Industrial CO2 Emissions Reduction and Trend Prediction. *Atmospheric Pollution Research, 10*(5), 1627-1635. https://doi.org/10.1016/j.apr.2019.06.003.

Zeren, F. (2015). Doğrudan Yabancı Yatırımların CO2 Emisyonuna Etkisi: Kirlilik Hale Hipotezi mi Kirlilik Cenneti Hipotezi mi? *Yaşar Üniversitesi E-Dergisi*, *10*(37), 6442-6448. https://doi.org/10.19168/jyu.97848.

Zhao, Z.-xiu, Wang, R., and Yun-feng, Y. A. N. (2013). Embodied Carbon Emission and Pollution Heaven Hypothesis: Re-Explaining Environmental Kuznets Curve. *Journal of International Trade,* 7, 93–101. https://doi.org/10.13510/j.cnki.jit.2013.07.004.

Zhao, B., and Yang, W. (2020). Does Financial Development Influence CO2 Emissions? A Chinese Province-Level Study, *Energy,* 200, 117523. https://doi.org/10.1016/j.energy.2020.117523.