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Tourism, Tourism Volatility and Economic Growth in Pakistan: New Evidence from NARDL Approach

Maria Mazhar[*]
Muhammad Tariq Majeed[**]
Saira Tufail[***+]

Abstract: *Tourism has emerged as the world's fastest-growing industry in the modern period. Meanwhile, its volatile nature is attracting worldwide attention, since sustainable tourism is important in light of the Sustainable Development Goals (SDGs). This study explores the non-linear relationship between international tourism, its volatility, and economic growth in Pakistan. The analysis covered the period from 1960 to 2020. The empirical analysis is carried out employing the recently popularized approach of non-linear autoregressive distributed lag (NARDL). The NARDL results suggest the asymmetrical relationship between the variable of interests in both the short term and the long term. The coefficient of positive (negative) shock for international tourism revenues has a positive (negative) sign and is statistically significant implying that every increase (decrease) in international tourism revenues leads to an increase (decrease) in economic growth. Conversely, the coefficient of positive (negative) shock for the volatility of international tourism revenue has a negative (positive) sign and is statistically significant, suggesting that any increase (decrease) in the volatility of international tourism revenue leads to a decrease (increase) in economic growth. Based on the study outcomes, the study suggests that the government of Pakistan needs to take structural measures to attain sustainable tourism that in turn increases growth sustainability.*

Keywords: tourism industry; tourism volatility; tourism activities; NARDL; Pakistan; asymmetric analysis; tourism led growth hypothesis

JEL Classification:

[*] Quaid-i-Azam University, Islamabad, Pakistan.
[**] Quaid-i-Azam University, Islamabad, Pakistan.
[***] Fatima Jinnah Women University, Rawalpindi, Pakistan.
[+] Corresponding Author E-Mail: sairatufail@fjwu.edu.pk

Introduction

In recent decades, with the new modes of transportation and the discovery of several new destinations and historical civilizations, the tourism industry has emerged as the world's fastest and biggest sector of the economy (Kester & Croce, 2011). The sector has evolved into a strategic economic zone essential to the socio-economic progress of countries worldwide. It is a key engine of cultural transformation, job creation, social development, foreign exchange revenue, investment attraction, and economic progress (Gössling & Hall, 2006). According to the United Nations World Tourism Organization (UNWTO, 2017), tourism can alter the economic status of recipient countries. According to the WTO (2021), the number of destinations with a turnover of one billion or more dollars has nearly doubled since 1998. International arrivals increased significantly in 2019, though slower than in 2017 (+7%) and 2018. In 2019, all regions saw an increase in arrivals, led by the Middle East (+8 percent), Asia and the Pacific (+4 percent), and Europe (+4 percent).

In 2017, Asia-Pacific was both the second-largest destination for international visitors and the second-largest volume of international tourist revenues. South Asia is the least competitive when compared to other regions, but it has seen the fastest rates of improvement since the last issue of the report, including the largest percentage increase in information and communication technology (ICT) readiness scores in sub-regions. Pakistan is a kaleidoscope of some of the world's most diverse natural beauties in the South Asian region. In recent years, the country's tourism industry has grown at a faster rate. Lonely Planet called Pakistan tourism's next big thing for more years than we care to remember in 2010.

In October 2006, The Guardian published "the top five tourist destinations in Pakistan" to help the country's tourism economy. The World Economic Forum (WEF; 2009) named Pakistan as one of the top 25% of tourism destinations in the world due to its United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage sites. The British Backpacker Society named Pakistan the world's top adventure travel destination in 2018, describing the country as one of the most pleasant countries on earth, with mountain beauty beyond anyone's wildest imagination (IP, 2019).

Its favorable impact on the Pakistani economy may help the country in a multitude of ways, including increased tourism revenues, personal income, education and health expenditures, and investment and employment possibilities, all of which lead to higher growth. Despite its positive impact, tourism has the potential to degrade environmental quality. For example, more visitors use more energy (derived from fossil fuels), electricity (derived from oil production, coal, and so on), and transportation facilities (Robaina-Alves et al., 2016), which increases pollutant emissions or environmental degradation. The deterioration of the environment raises output volatility by diminishing natural and human resources and undermines long-term growth (Majeed & Mazhar, 2019). When there are negative trends in tourism, the opposite reaction might

be seen. A decrease in the number of tourists and tourism expenditure will result in lower personal and national income, employment opportunities, and investment, resulting in low growth. With lesser growth and economic activity, environmental quality will improve, leading to higher growth. This implies that the relationship between tourism and economic growth is non-linear (Kumar et al., 2020; Kumar et al., 2022).

Similarly, a consistent rise in tourist arrivals will result in long-term growth, demonstrating that lowering uncertainty and boosting sustainable tourism improve the country's development. A steady growth in tourism means a consistent contribution to the country's development in the form of stable income, a stable increase in employment possibilities, and so on. However, travel trends fluctuate often, indicating greater unpredictability. The number of tourist visits is unpredictable due to the country's economic, political, and trade disputes, the global economic slump, and environmental and security concerns (Abbas & Ibrahim, 2011). This is evident from the recent COVID-19 pandemic thats has placed countries on local and global lockdowns, limiting national and international travel. In this period, tourism is severely impacted and remains volatile at both the national and international levels (Gössling et al., 2021), further lowering global growth rates (OECD, 2020; Majeed & Mazhar, 2021). This gives the impression that the overall impact of both tourism and tourism volatility is not linear as the rise and fall in tourism and tourism volatility affect economic growth differently. Thus, existing research on tourism, tourism volatility, and economic growth in a linear setting is subject to empirical questions.

The current study aims to examine tourism led growth hypothesis and extend the analysis by providing answers to the following questions. (i) Is there any impact of international tourism receipts on the economic growth of Pakistan's economy? (ii) If yes, whether the impact is linear or non-linear? (iii) Does the volatility of international tourism receipts impact economic growth? (iv) If yes, whether the impact is linear or non-linear? The answers to these questions will provide important policy implications for the Pakistan Tourism Development Corporations (PTDC) and other related authorities for formulating their policy objectives regarding tourism. Further, through this attempt, this study contributes to the existing stock of knowledge in many ways. First, to the best of our knowledge, this is the first study of its type that examines the non-linear effect of tourism on economic growth in Pakistan. Second, this is the first study that examines the non-linear effect of international tourism volatility on economic growth. Third, this study is the first attempt to uncover the asymmetric impacts of international tourism volatility on the economic growth of Pakistan. Lastly, for the asymmetric investigation, the study employs the recently recognized NARDL estimation techniques.

The remaining part of the study is organized as follows: Section 2 will review the related theoretical and empirical literature, section 3 will present the data and methodology to be followed, section 4 will discuss the study results, and the last section will conclude the study.

Literature Review

The literature has advanced four major hypotheses concerning the relationship between tourism and economic growth. The first is the ***Tourism-Led Growth (TLG) Hypothesis*** pioneered by Balaguer and Cantavella-Jorda (2002), which considers tourism the most significant factor in long-term economic growth. Second, the ***Economic Driven Tourist Growth Hypothesis (EDTG)*** proposed by Lin, Yang, and Li (2018) suggests that well-defined economic and international trade policies, improved governance, physical and human capital investment, and socioeconomic prosperity drive tourism activity in a country, hence establishing unidirectional causation from economic growth to tourism. Third, ***Neutrality Hypothesis (NH)*** primarily studied by Wu and Wu (2019) deliberates that economic growth and tourism are unrelated and have no causal relationship. Finally, the ***Bidirectional Hypothesis (BH)***, notably explored by Han and Song (2018) demonstrated a bidirectional association between economic growth and tourism.

In addition to the theoretical discussion, the researchers have attempted to examine TLG, EDTG, NH, and BH for various samples. For instance, Lin, (2024) explored TLG across 203 countries, confirming tourism's positive impact on economic growth, particularly when sustainable competitiveness is prioritized. Kumar et al., (2024) investigated TLG in Tonga, finding unidirectional causality from tourism to economic growth using advanced econometric models.

Hijazi et al., (2024) provided empirical evidence for TLG in Pakistan, demonstrating a long-run relationship between tourism and economic growth and Raifu and Afolabi (2024) validated TLG despite structural breaks, indicating its robustness in varying economic conditions. Srinivasan et al. (2012) performed an analysis of the Sri Lankan economy considering the period from 1969 to 2009. Their ARDL analysis confirms the positive association between the concerned variables for both the short and long run. Hence, the TLG hypothesis is confirmed for the Sri Lankan economy.

Overall TLG highlights tourism's role in enhancing GDP, creating jobs, and generating tax revenues, which are crucial for economic stability (Tang, 2022). The findings from these studies suggest that policymakers should focus on developing tourism infrastructure and sustainable practices to maximize economic benefits (Lin, 2024; Hijazi et al., 2024). While TLG has garnered substantial support, some critics argue that over-reliance on tourism can lead to economic vulnerabilities, particularly in times of global crises, suggesting a need for diversified economic strategies.

The literature also showed that the relationship between tourism and economic growth exhibits a complex bi-directional causality, influenced by various factors such as country development levels and tourism specialization. Research indicates that in many contexts, tourism acts as a catalyst for economic growth, while in more developed regions, economic growth can enhance tourism opportunities. Specifically, in

countries with high tourism specialization, economic development can foster tourism growth, indicating a reciprocal relationship (Cárdenas-García et al. 2024; Lanzilotta et al., 2024). In Asia, positive shocks in tourism revenues correlate with economic growth, suggesting that fluctuations in tourism can significantly impact economic performance.

Lean & Tang (2010) by utilizing a rolling subsample causality test have asserted the stable long-run connections between tourism and the economic growth of Malaysia. Another strand of literature came up with the objective of evaluating the EDTG by taking a variety of samples. Economic growth can lead to increased disposable income, which boosts both domestic and international tourism demand. This is evident in studies showing that as economies grow, inbound tourism demand tends to expand more significantly than domestic tourism demand (Wu & Wu, 2019; Pulido-Fernández, et al., 2020). Kum et al. (2015) for the Next-11 countries argued that tourism positively affects economic activities and thus leads to higher growth rates in these economies suggesting the EDTG hypothesis. Taking the Sri Lankan economy's data Suresh & Senthilnathan (2014) perform an analysis by utilizing the causality and cointegration tests. They find that one-way relation exists among the concerned variables running from growth to tourism. With a similar objective, Alhowaish (2016) studies the links between tourism and economic growth for the Gulf Cooperation Council (GCC)**.** Through the panel Granger causality test, they confirm the EDTG theory for these economies. Further, in the country-specific case, the results are mixed as for some nations EDTG hypothesis is confirmed, for some TLG theory is validated and no relationship exists among the variables of interest.

In contrast, Samimi et al. (2011) for the case of developing economies find the two-way causality between tourism and economic growth suggesting tourism important for economic growth as well as development significance for tourist attraction. In a similar context, Ekanayake & Long (2012) suggest the TLG hypothesis for the panel of developing countries.

Regarding the tourism volatility-growth relationship, Sakr & Massoud (2003) argued that law and order situations, political tensions, critical social issues, environmental quality, and security concerns largely affect the tourism sector and thus the growth rates. Further, the pandemic diseases mainly the recent COVID-19 make the industry highly volatile (Gössling et al., 2021) that in turn squeezes the worldwide growth rates (OECD, 2020). Apart from these theoretical explanations, Majeed & Mazhar's (2021) work is the only scientific assessment of the tourist volatility-growth relationship. Their analysis utilizes the panel data of 155 countries and confirms the BH for the group of 155 countries.

Based on the literature review, this study contributes to the existing literature in a variety of ways. This is the first study to look at the asymmetric impact of tourism on economic growth in Pakistan. We find very few studies on this topic in previous literature, such as the study by Kumar et al. (2020) for Cook Island and Kumar et al.

(2022) for Papua New Guinea, which investigated the non-linear impacts of tourism on economic growth. Third, this is the first study that explores the asymmetric effects of international tourism volatility on economic growth. Finally, the study improves the methodology for examining the asymmetric relationship between the variables under consideration. In this regard, the study makes use of the recently popularized NARDL technique.

Data and Methodology

Model Specification and Data

The present study aims to scrutinize the non-linear impacts of international tourism receipts and its volatility on Pakistan's economic growth. For this reason, the research spans the years 1960 to 2020, with data sourced from the World Bank (2022). Following the tourism-growth literature and especially the study by Majeed & Mazhar (2021), the simple linear regression model is expressed as follows:

$$LGDP_t = \beta_0 + \beta_1 LITR_t + \beta_2 LVITR_t + \beta_3 LINF_t + \beta_4 LGC_t + \beta_5 POPG_t + \mu_t \quad (1)$$

Where,
t is the time period from 1960 to 2020.
LGDP = log of Gross Domestic Product (Constant 2015 US$)
LITR = log of international tourism receipts (Log of international tourism receipts (Current US$)
LVITR = log of the volatility of international tourism receipts (5-year moving standard deviation)
LINF = log of consumer prices index.
LGC = log of general government final consumption (Constant 2015 US$)
POPG = population growth

The inclusion of variables in the equation has strong theoretical justification. Tourism contributes to economic growth through foreign exchange earnings, increased employment (Wu et al., 2023), and enhanced investment in infrastructure. Higher tourism receipts also lead to higher economic activity and lead to improved demand of accommodation, transportation, and local goods and services (Lin 2024). Increased tourism can attract foreign direct investment, enhancing infrastructure and services (Perles-Ribes et al., 2024). Tourism-led growth hypothesis provides the channels through which tourism contributes to economic growth. Tourism receipts become volatile with fluctuations in foreign demand for domestic tourism services. This volatility is transmitted into uncertainty in GDP growth, leading to economic growth reduction. Research indicates that while tourism can drive economic growth

its volatility can hinder this relationship, particularly in low and middle-income countries (Risso, 2018). Instability in tourism can have dire economic consequences, particularly for those countries that are heavily relying on tourism for growth. Inflation impacts the economy through a variety of channels and may have varying effects depending on its level. For instance, a high level of inflation may deter growth but a moderate level of inflation induces economic growth. Government expenditures, reflecting the stance of fiscal policy, affect economic growth through many channels. These channels include enhanced productivity and competitiveness (social and economic infrastructure development (Khalid and Batool, 2024), and increased human capital (Zulkifli et al., 2024). The relationship between population and economic growth is complex and multifaceted, reflecting both historical trends and contemporary challenges. While population growth can drive economic expansion by increasing labor supply and consumer demand (Kuznets, 2016), it can also strain resources and infrastructure if not managed effectively (Benmoussa, 2023).

For assessing the asymmetric growth impacts of international tourism receipts and their volatility, we have employed the NARDL methodology developed by Shin et al. (2014). Prior to this, the stationary of the variables is checked through ADF, PP, and Zivot–Andrews unit root test.

NARDL is the extension of ARDL model that provide asymmetric impact present due to the positive and negative shocks in the particular series. Further, it provides efficient estimates where variables have mixed order of integration or integrated of order one. Moreover, its cointegration system permits for the "co-joint of asymmetric non-linearity" and exhibits cointegration in a particular equation, and thus more appropriate for small sample sizes. The long run NARDL model can be expressed as:

$$\begin{aligned} LGDP_t = {} & \delta_0 + \delta_1^+ LITR_t^+ + \delta_2^- LITR_t^- + \delta_3^+ LVITR_t^+ + \delta_4^- LVITR_t^- \\ & + \delta_5 LINF_t + \delta_6 LGC_t + \delta_7 POPG_t + \mu_t \end{aligned} \tag{2}$$

Eq. 2 is the asymmetric version of eq. 1, where δ_0, δ_1^+, δ_2^-, δ_3^+, δ_4^-, δ_5, δ_6, and δ_7 are the vector of unknown long-run parameters. Here, $LITR_t^+$, $LITR_t^-$, $LVITR_t^+$, and $LVITR_t^-$, are the partial sum of positive and negative changes in LITR and LVITR, respectively.

$$LITR_t^+ = \sum_{j=0}^{t} \Delta LITR_j^+ = \sum_{j=0}^{t} \max(\Delta LITR_j, 0) \tag{3}$$

$$LITR_t^- = \sum_{j=0}^{t} \Delta LITR_j^- = \sum_{j=0}^{t} \min(\Delta LITR_j, 0) \tag{4}$$

$$LVITR_t^+ = \sum_{j=0}^{t} \Delta LVITR_j^+ = \sum_{j=0}^{t} \max(\Delta LVITR_j, 0) \tag{5}$$

$$\mathrm{LVITR}_t^- = \sum_{j=0}^{t} \Delta\,\mathrm{LVITR}_j^- = \sum_{j=0}^{t} \min\left(\Delta\mathrm{LVITR}_j, 0\right) \tag{6}$$

In the presence of asymmetric variables, the NARDL model capture the long and short run impacts is as follows:

$$\begin{aligned}\Delta\mathrm{LGDP}_t = {} & \gamma_o + \gamma_1\mathrm{LGDP}_{t-i} + \theta_2^+\mathrm{LITR}_{t-1}^+ + \theta_3^-\mathrm{LITR}_{t-1}^- + \theta_4^+\mathrm{LVITR}_{t-1}^+ \\ & + \theta_5^-\mathrm{LVITR}_{t-1}^- + \theta_6\mathrm{LINF}_{t-1} + \theta_7\mathrm{LGC}_{t-1} + \theta_8\mathrm{POPG}_{t-1} \\ & + \sum_{i=1}^{p} \varphi_i\Delta\mathrm{LGDP}_{t-i} + \sum_{i=0}^{a} \left(\emptyset_i^+\,\Delta\mathrm{LITR}_{t-i}^+ + \emptyset_i^-\,\Delta\mathrm{LITR}_{t-i}^- \right) \\ & + \sum_{i=0}^{b} \left(\tau_i^+\,\Delta\mathrm{LVITR}_{t-i}^+ + \tau_i^-\,\Delta\mathrm{LVITR}_{t-i}^- \right) + \sum_{i=0}^{c} \omega_i\Delta\mathrm{LINF}_{t-i} \\ & + \sum_{i=1}^{d} \omega_i\Delta\mathrm{LGC}_{t-i} + \sum_{i=0}^{e} \omega_i\Delta\mathrm{POPG}_{t-i} + \varepsilon_t\end{aligned} \tag{7}$$

Where a, b, c d, and e are indicating the order of lag of a respective variable. In Eq. 2, there may be the presence of uncovered cointegration, and its asymmetric results may not be reliable. Hence, to tackle this Eq. 2 coefficients are restricted in a way that $\delta_1^+ = {-\theta_2^+}/{\gamma_1}$ & $\delta_2^- = {-\theta_3^-}/{\gamma_1}$ and $\delta_3^+ = {-\theta_4^+}/{\gamma_1}$ & $\delta_4^- = {-\theta_5^-}/{\gamma_1}$. On the other hand, an increase in LITR impact in short is estimated through $\sum_{i=1}^{a} \emptyset_i^+$ while decrease in LITR impact (in short run) is estimated through $\sum_{i=1}^{b} \emptyset_i^-$. Similarly, an increase in LVITR impact in short is estimated through $\sum_{i=1}^{a} \tau_i^+$ while decrease in LVITR impact (in short run) is estimated through $\sum_{I=1}^{b} \tau_i^-$. Hence, the Eq 7 estimates the non-linear (asymmetric) impact of LITR and LVITR on economic growth of Pakistan in both short run as well as in the long run. Based on this the error correction model (ECM) is expressed in the following equation:

$$\begin{aligned}\Delta\mathrm{LGDP}_t = {} & \sum_{i=1}^{p} \vartheta_i\Delta\mathrm{LGDP}_{t-i} + \sum_{i=0}^{a} \left(\alpha_i^+\,\Delta\mathrm{LITR}_{t-i}^+ + \alpha_i^-\,\Delta\mathrm{LITR}_{t-i}^- \right) \\ & + \sum_{i=0}^{b} \left(\rho_i^+\,\Delta\mathrm{LVITR}_{t-i}^+ + \rho_i^-\,\Delta\mathrm{LVITR}_{t-i}^- \right) + \sum_{i=0}^{c} \sigma_i\Delta\mathrm{LINF}_{t-i} \\ & + \sum_{i=1}^{d} \pi_i\Delta\mathrm{LGC}_{t-i} + \sum_{i=0}^{e} \beth_i\Delta\mathrm{POPG}_{t-i} + \aleph_i\mathrm{ECT}_{t-i} + \varepsilon_t\end{aligned} \tag{8}$$

Where ϑ_i, σ_i, π_i, and $\beth_i$ are the short run coefficients while α_i^+, α_i^-, and ρ_i^+, ρ_i^- depicts the short run symmetry adjustment. Lastly, $\aleph_i$ signifies the coefficient of ECT.

After the above specification general to specific methods has been utilized via lessening the insignificant lags. Further, NARDL bound testing approach is considered for confirming the long run associations among the variables of interest. The null hypothesis of "no cointegration" is checked against the alternative hypothesis of "cointegration exits." The test consists of Wald F-test hypothesis. Finally, based on cointegration existence, the long and short run asymmetric impact of LITR and LVITR on LGDP is estimated. Additionally, the "asymmetric cumulative multiplier effect" of one % changes in $LITR_{t-i}^+$ & $LITR_{t-i}^-$ and $LVITR_{t-i}^+$ & $LVITR_{t-i}^-$ is computed in a following manner:

$$K_b^+ = \sum_{j=0}^{b} \frac{\partial LGDP_{t+j}}{\partial LITR_{t-1}^+}, K_b^- = \sum_{j=0}^{b} \frac{\partial LGDP_{t+j}}{\partial LITR_{t-1}^-}, b = 1,2,3 \quad (9)$$

$$K_c^+ = \sum_{j=0}^{c} \frac{\partial LGDP_{t+j}}{\partial LVITR_{t-1}^+}, K_b^- = \sum_{j=0}^{c} \frac{\partial LGDP_{t+j}}{\partial LVITR_{t-1}^-}, c = 1,2,3 \quad (10)$$

Here, the terms denote that $b \to \infty$, $K_b^+ \to \delta_1^+$, & $K_b^- \to \delta_2^-$ and $K_c^+ \to \delta_3^+$, & $K_c^- \to \delta_4^-$.

Stylized Facts

Figure 1 shows trends of major tourism-related variables, the relationship between tourism receipts, and its volatility with economic growth. The first panel exhibits that though tourist arrivals and expenditures are increasing, Pakistan faces challenges in maintaining and increasing tourism receipts. The second panel supports that boosting tourism receipts can positively affect GDP. The third panel suggests that reducing the volatility of tourism receipts is crucial for ensuring stable economic growth. According to the report by the World Economic Forum (2024) low to middle-income economies exhibited the most significant enhancement in performance since 2019, accounting for 52 out of 71 economies that improved their Tourism and Travel Competitive Index (TTCI) scores. Between 2019 and 2024, these economies accounted for much of the above-average improvements. Pakistan experienced an improvement in its Travel and Tourism Competitiveness Index (TTCI) during this period. In 2013, the country's TTCI ranking declined due to weak regulations and policies (Hye & Khan, 2013). In 2017, Pakistan faced its lowest rankings in areas such as visa requirements (135th out of 136 countries), tourism branding and promotion (125th), quality of tourism infrastructure (123rd), and availability of hotel rooms (129th).

However, the rankings showed improvement in 2019 and 2022, largely attributed to the efforts of provincial governments (Figure 2). For instance, the Punjab government registered 640 new hotels and restaurants following devolution and initiated the restoration and renovation of various tombs and archaeological sites. The introduction of public facilities such as washrooms, golf carts, benches, and heritage rickshaws further boosted tourist numbers (Ahmed et al., 2022).

To enhance its global standing, the Pakistani government has implemented several measures, including improving the business environment, upgrading tourism services, ensuring safety and security, enhancing health-related facilities, and building socio-economic resilience. Despite these efforts, Pakistan's performance remains significantly below the global and regional medians (Figure 3).

Figure 1: Tourism and Economic Growth

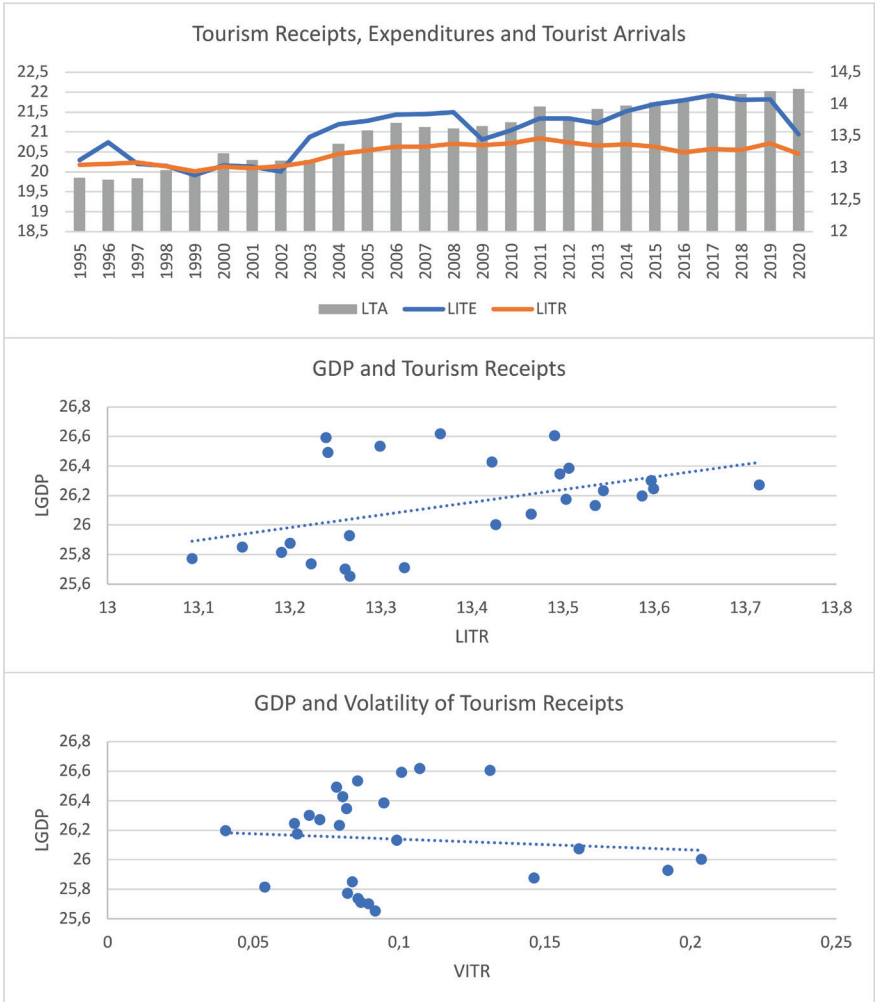
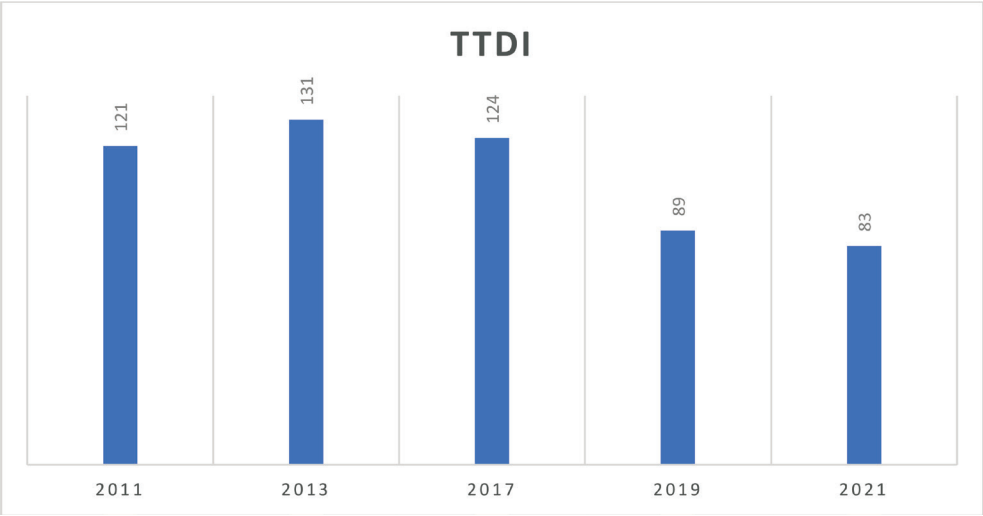
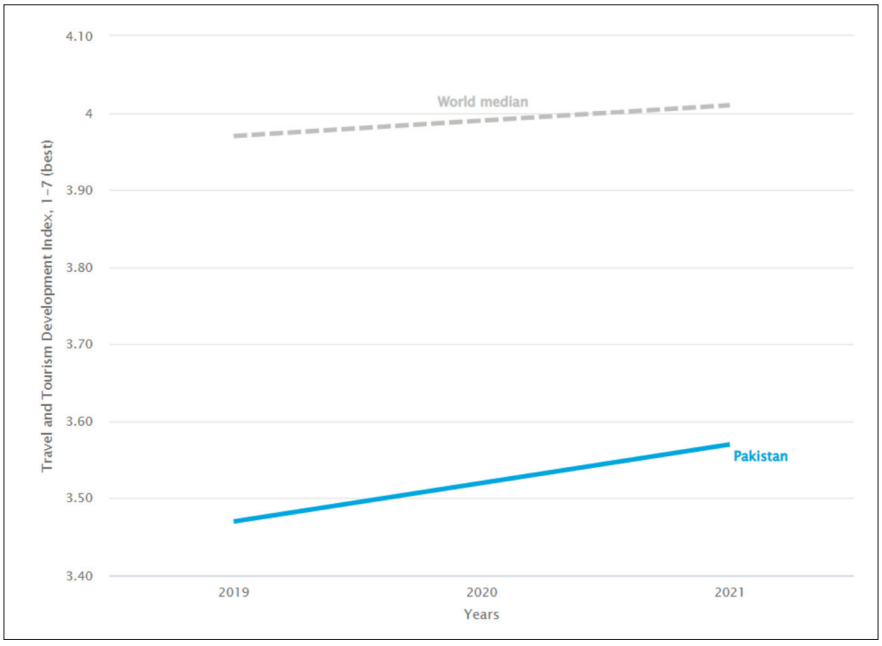


Figure 2: Travel and Tourism Development Index



Source: Data is taken from the World Economic Forum

Figure 3: TTDI, Pakistan, and the World



Source: World Economic Forum

Result and Discussion

Descriptive and Correlational Analysis

Table 1 reports the descriptive statistics for the dependent variable GDP and independent variables.

Table 1: Descriptive and Correlational Analysis

	GDP	ITR	VITR	INF	GC	POPG
Mean	901.69	631186.7	-183875.3	8.0157	1.22E+10	2.6521
Median	924.63	631374.9	-113768.5	7.1893	1.10E+10	2.6845
Max	1502.89	904685.0	265612.6	26.663	4.10E+10	3.3639
Min	379.02	0.000000	-693241.5	-0.5164	1.50E+09	1.9783
Std. Dev.	322.69	111283.6	260914.7	5.1765	1.04E+10	0.4011
Obs.	61	61	61	61	61	60
Correlation						
GDP	1					
ITR	-0.087	1				
VITR	0.948	-0.177	1			
INF	0.093	0.128	0.128	1		
GC	0.940	-0.128	0.804	0.039	1	
POPG	-0.590	-0.135	-0.402	0.078	-0.710	1

Results of Unit Root Tests

Table 2 demonstrates the results of unit root at the level. According to the ADF test, all the variables (except POPG) are stationary at level (based on trend) while only LITR and LVITR are stationary at level (based on trend and intercept). By the PP (1988) unit root test LGDP, LITR and LVITR are stationary at level (based on intercept) and only LITR and LVITR are stationary at level (based on trend and intercept). About the Zivot-Andrew (1992) unit root test (with structural breaks) all the variables are stationary at level (based on intercept) except LGC while all are stationary at level (based on trend and intercept) except LINF and LGC.

Table 2: Unit Root Test (At Level)

	LGDP	LITR	LVITR	LINF	LGC	POPG
ADF Unit Root Test (Level)						
Intercept	-2.9430**	-2.0240	-4.9801***	-4.7289***	-0.8872	-0.7734
	(0.0464)	(0.2761)	(0.0005)	(0.0003)	(0.7856)	(0.8187)
Int & trend	-2.1074	-2.0284	-5.9413***	-4.7872***	-2.9163	-2.1162
	(0.5311)	(0.5739)	(0.0003)	(0.0014)	(0.1649)	(0.5256)
ADF Unit Root Test (First Difference)						
Intercept	-	-7.3074***	-	-	-10.251***	-2.0365
		(0.0000)			(0.0000)	(0.2708)
Int & trend	-6.4549***	-7.2345***	-	-	-10.202***	-2.4177
	(0.0000)	(0.0000)			(0.0000)	(0.3668)
PP Unit Root Test (Level)						
Intercept	-2.7355*	-2.3294	-4.9746***	-4.7321***	-0.6846	-0.4679
	(0.0741)	(0.1664)	(0.0006)	(0.0003)	(0.8424)	(0.8896)
Int & trend	-2.1484	-2.3332	-5.9029***	-4.8066***	-2.8263	-1.9314
	(0.5088)	(0.4099)	(0.0004)	(0.0014)	(0.1940)	(0.6256)
PP Unit Root Test (First Difference)						
Intercept		-7.3796***	-	-	-10.284***	-2.3687
		(0.0000)			(0.0000)	(0.1550)
Int & trend	-6.4641***	-7.3124***	-	-	-10.246***	-2.6394
	(0.0000)	(0.0000)			(0.0000)	(0.2652)
Zivot–Andrews Unit Root Test (Level)						
Intercept	-3.529***	-5.365***	-7.259***	-5.714**	-4.434	-4.046*
	(0.000)	(0.000)	-	(0.025)	-	(0.074)
	[1980]	[2004]	[2008]	[1970]	[1996]	[1972]
Int & trend	-3.182***	-4.898***	-5.466***	-4.660	-3.112	-5.374**
	(0.002)	(0.001)	-	(0.693)	-	(0.016)
	[1980]	[2008]	[2015]	[1974]	[1986]	[1978]
Zivot–Andrews Unit Root Test (First Difference)						
Intercept	-	-	-	-	-3.44**	-
					(0.015)	
					[1997]	
Int & trend	-	-	-	-5.583	-4.043***	-
				(0.861)	(0.007)	
				[1974]	[1998]	

Unit root tests at the level show that although most of the variables are stationary at a level some are non-stationary. Therefore, we have checked the unit root of each series at the first difference on both intercept and at intercept and trend for those variables. The overall findings of unit root tests show that some variables are stationary at level, and some become stationary after taking their first difference suggesting a mixed order of integration. Therefore, to proceed further the most efficient methodology is ARDL and the recently popular version of NARDL.

Results of NARDL

The Optimal Lag Selection

The optimal lags are selected using the minimum value of the BIC criterion Based on the criterion the ARDL specification model is (1 0 0 0 0 0 1 0).

The NARDL Bound Test

To check the long-run relationship among the variables included in the NARDL model, bound test is applied (table 3). The results show that the test F-statistics is 4.521 which is greater than all the critical values of the upper bound at 10% (3.13), 5% (3.5), 2.5% (3.84), and, 1% (4.26), rejecting the null hypothesis of "no long-run relationship" and indicating the existence of non-linear long-run relationship.

The NARDL Estimates

The NARDL estimates for the long run and short run are indicated in table 6. The results suggest that the impact of LITR on economic growth is statistically significant and asymmetric both in the long and short run. The coefficient size in the long run is 0.3210 (for positive shock) and 0.3012 (for negative shock) and for the short run 0.1253 (for positive shock) and 0.1176 (for negative shock). The Wald test shows that these coefficients are statistically different both in the long and short run indicating the asymmetries in the size of the relationship. Our results conform to Iqbal et al., (2024) that also show a statistically significant link between tourism development and GDP growth in Pakistan**.** Jan. et al., (2023) also show that tourism receipts have a favorable influence on GDP in the long run, although their impact may be less pronounced in the short term. The tourism sector enhances labor force participation, contributing to overall economic activity (Amjad et al., 2022) and there is a pressing need for government investment in tourism infrastructure and services to attract more visitors (Hijazi et al., 2024). While tourism presents significant opportunities for economic growth in Pakistan, challenges such as political instability and the need for better infrastructure must be addressed to fully realize its potential.

Similarly, both in the long run as well as in the short run the impact of LVITR on economic growth is statistically significant and asymmetric based on the varied coefficient size of positive shock (0.0264) and negative shock (0.1349) for the long run, and positive shock (0.0103) and negative shock (0.0527) for the short run. These findings are in line with Majeed & Mazhar (2021) that fluctuations in international tourism receipts hurt the growth rate and negatively influence the development process by causing fluctuations in tourism-related benefits (and vice versa holds).

The coefficient of LINF (LGC) carries a negative (positive) sign of 0.0021 (0.872) (for the long run) and 0.0008 (0.340) (the short run) and is insignificant suggesting

no influence on economic growth. Lastly, the coefficient of population growth is statistically significant and negatively (positively) related to economic growth in the long run (short run). In the short run, an increase in population leads to higher consumption demand for goods and services. This can stimulate economic growth as businesses expand production to meet demand. Increased population might also lead to higher government spending on infrastructure, healthcare, and education, further boosting economic activity. Over time, rapid population growth can strain natural resources, infrastructure, and public services. This creates bottlenecks in production, transportation, and access to basic needs, reducing economic efficiency and growth. As the labor force grows, if the capital stock (machines, infrastructure, technology) does not increase proportionately, diminishing returns to labor set in, reducing productivity. Agarwal (2014) supports the finding.

The ECT carries a negative sign and is statistically significant at a 1 % level of significance. It signifies that our model is stable and any disequilibrium in the level of economic growth will be corrected in the long run at the speed of 39 %. In the diagnostic test, R^2 indicates that our model is good fitted. The Wald tests reconfirm the asymmetric impact of LITR and LVITR on Pakistan's economic growth.

Table 3: Estimates of NARDL

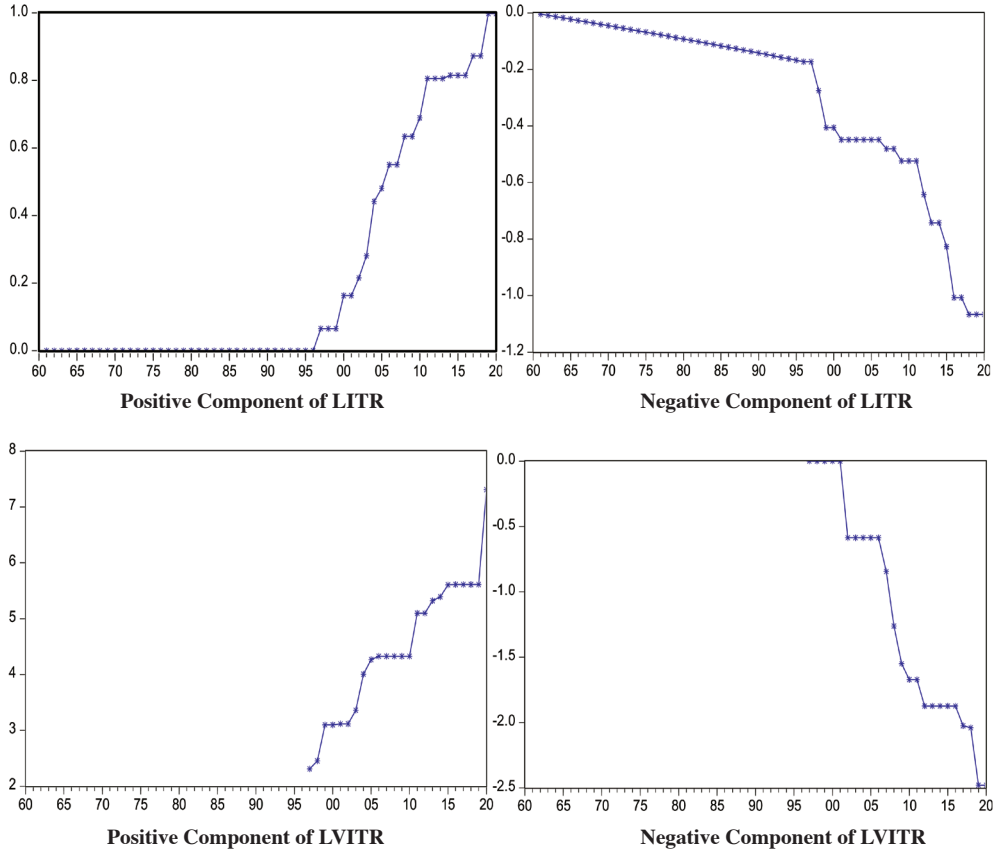
Dependent Variable: LGDP			
Variables	**Long-run Coefficient**	**Standard Error**	**t-statistics**
$LITR^+$	0.3210**	0.1280	2.5062
$LITR^-$	-0.3012***	0.0525	-5.7318
$LVITR^+$	-0.0264**	0.0124	-2.1231
$LVITR^-$	0.1349***	0.0342	3.9451
LINF	-0.0021	0.0154	-0.1365
LGC	0.0872	0.0519	1.6797
POPG	-0.2328***	0.0806	-2.8854
Constant	5.5314**	1.2427	4.4510
Variables	**Short-run Coefficient**	**Standard Error**	**t-statistics**
Δ $LITR^+$	0.1253**	0.0445	2.8130
Δ $LITR^-$	-0.1176***	0.0279	-4.2136
Δ $LVITR^+$	-0.0103**	0.0047	-2.1595
Δ $LVITR^-$	0.0527***	0.0083	6.3079
Δ LINF	-0.0008	0.0058	-0.1395
Δ LGC	0.0340	0.0245	1.3874
Δ POPG	0.1743***	0.0507	3.4336
ECT (-1)	-0.3906***	0.0923	-4.2307

Dependent Variable: LGDP			
Diagnosis Tests			
R^2	0.75	Adjusted R^2	0.592
F-statistics	4.552 (0.000)	Log-Likelihood	76.655
$\chi^2_{L.M}$	3.250 (0.578)		
Wald Test 1	4.485 (0.000)	Wald Test 2	-4.055 (0.001)
NARDL Bound Test			
F-statistics	4.521		
	Lower Bound = 2.03 Upper Bound= 3.13 at 10%		
	Lower Bound = 2.32 Upper Bound =3.5 at 5%		
	Lower Bound = 2.6 Upper Bound =3.84 at 2.5%		
	Lower Bound = 2.96 Upper Bound =4.26 at 1%		
Note: ***, ** represents 1% and 5% level of significance. $\chi^2_{L.M}$shows the LM test for serial correlation.			

Disintegration of Asymmetric Components

After confirming the asymmetric relationship among the LITR, LVITR, and LGDP, we have disintegrated the negative and positive components of both variables and shown in Figure 4. The disaggregation of positive and negative components allows us to study the asymmetry in how increases and decreases in LITR and LVITR affect LGDP. For example: a positive shock in LITR (e.g., growth in tourism revenue) may have a different impact on LGDP compared to a negative shock (e.g., a decline in tourism revenue). Similarly, increases in volatility (positive LVITR) might hurt GDP more than decreases in volatility (negative LVITR) contribute to economic stability. The cumulative trends indicate specific time periods of growth (positive components) and decline (negative components) in tourism revenue and its volatility. For instance, the sharp increases or decreases in the curves suggest significant external shocks, such as global financial crises, pandemics, or policy interventions, that impacted tourism revenue and its volatility. Disaggregating positive and negative components helps capture the nuanced, non-linear impact of tourism revenue and its volatility on economic growth. A rise in LITR might boost GDP significantly, but a decline in LITR might lead to a disproportionate negative impact. Similarly, increased volatility in tourism revenue might hinder long-term investment and economic stability more than reduced volatility promotes them.

Figure 4: Disaggregated Components of Tourism Revenue and its Volatility



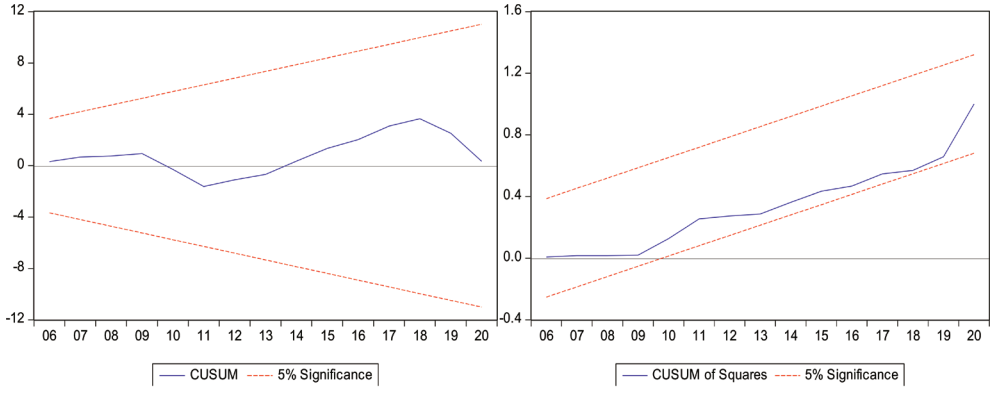
CUSUM and CUSUM Square Tests

The image shows the results of stability tests performed on a model using CUSUM (Cumulative Sum) and CUSUM of Squares tests. These tests are used to assess whether the model's coefficients remain stable over the sample period. The CUSUM test detects parameter instability in the model by plotting the cumulative sum of residuals over time. The blue line represents the cumulative sum of residuals. The red dashed lines represent the critical bounds at the 5% significance level. In this case, the blue line remains within the red lines, confirming the stability of the model.

The CUSUM of Squares test checks for more subtle forms of parameter instability, particularly variance changes (heteroskedasticity). The blue line represents the cumulative sum of squared residuals. In this case, the blue line does not cross the critical bounds, further supporting the model's stability. The stability tests confirm that the model remains consistent and robust over time. This means the relationships

estimated by the model are valid and can be trusted to analyze and interpret the data without concerns about significant parameter changes or instability (see figure 2).

Figure 5: Stability Test



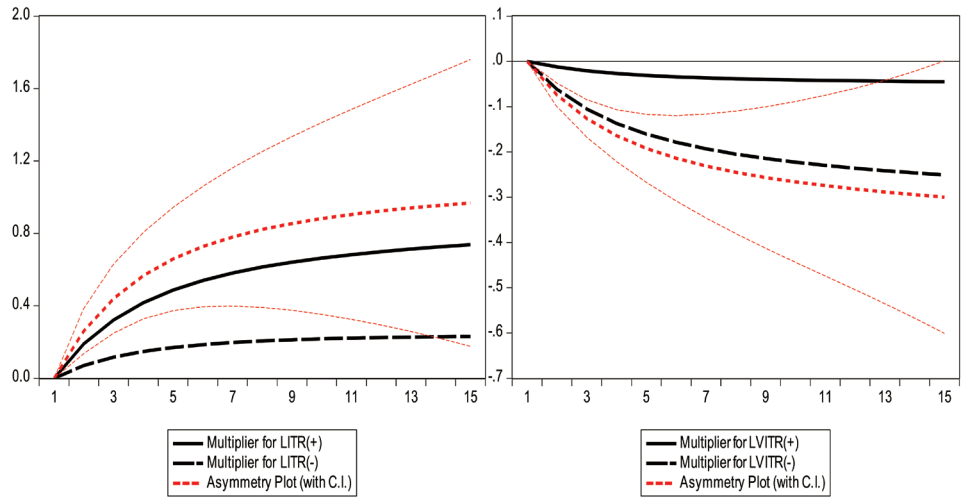
CUSUM Test **CUSUM of Square Test**

Dynamic Multiplier Graphs

The figure presents dynamic multiplier graphs for LITR and LVITR. The graphs display the short-run and long-run dynamic effects of positive and negative shocks to these variables on LGDP highlighting their asymmetric impacts over time. The horizontal axis represents the time horizon (in years). The vertical axis indicates the magnitude of the effect of shocks. The black solid line shows the impact of positive shocks to LITR (+). The black dashed line represents the effect of negative shocks to LITR (-). The red dashed line is the asymmetry plot, showing the difference between the positive and negative shocks along with confidence intervals.

Positive shocks to LITR have a significant and increasing impact over time, dominating in the long run. Negative shocks also have an effect, but the magnitude is lower compared to positive shocks. Negative shocks to LVITR have a more significant and dominant impact on LGDP, particularly in the long run. Positive shocks have a relatively weaker and diminishing effect over time. The asymmetry plot highlights the unequal adjustment of LGDP to positive and negative shocks of LITR and LVITR, reinforcing the asymmetrical nature of the relationship. For LITR, positive shocks dominate the dynamics and For LVITR, negative shocks have a stronger and more adverse effect on LGDP. This detailed analysis underscores the importance of accounting for non-linear and asymmetric effects when analyzing the relationship between tourism revenues, their volatility, and economic growth.

Figure 6: Dynamic Multiplier Graph



Dynamic Multiplier for LITR **Dynamic Multiplier for LVITR**

Conclusion and Policy Implications

The study employs the NARDL methodology to reveal the non-linear and asymmetric effects of international tourism receipts and their volatility on economic growth. The findings confirm that while positive shocks to tourism receipts significantly enhance growth, volatility, and negative shocks hinder it. This underscores the need for targeted policies to maximize the benefits of tourism and mitigate risks posed by revenue fluctuations.

By isolating positive and negative components, the analysis highlights the asymmetry in the relationship, emphasizing proactive measures to capitalize on positive tourism shocks—such as hosting international events—and establishing contingency mechanisms to buffer against negative shocks. Stabilizing tourism revenue through improved governance, consistent policies, and risk management is critical to long-term growth.

Pakistan's current initiatives align with these findings. Efforts by the Pakistan Tourism Development Corporation (PTDC), such as relaxing visa policies, enhancing intergovernmental coordination, and improving political stability and branding, reflect a commitment to boosting tourism while reducing its volatility. Projects like the Eco-system Restoration Initiative (ESRI), the establishment of Pakistan's first eco-tourism village in Kaghan Valley, and environmental initiatives such as the "zero emissions" metro line in Karachi, the Ten Billion Tree Tsunami, and bans on plastic use showcase an integrated approach to sustainable tourism. These steps are vital for

ensuring that tourism not only drives economic growth but also aligns with environmental sustainability. Continued focus on such innovative, eco-friendly, and resilient strategies will position Pakistan as a competitive and sustainable tourism destination.

The research has certain limitations and can be extended in various ways. The study focuses solely on international tourism and its volatility, omitting domestic tourism, which might play a crucial role in Pakistan's economic growth, given its large population and increasing domestic travel trends. The exclusion of domestic tourism could lead to an incomplete understanding of the overall impact of tourism on economic growth. Further research endeavors may focus on comparing the volatility impact of domestic and international tourism on economic growth. The study may also be extended the moderating effect of government spending on tourism infrastructure, exchange rate fluctuations and geopolitical factors that could significantly influence the relationship between tourism and economic growth.

Declarations

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Conflicts of interest/Competing interests

There is no conflict of interest/Competing interests

Availability of data and material

The data that support the findings of this study are openly available in the website of World Bank (www.worldbank.org).

Code Availability

The computer program results are shared through the tables in the manuscript.

Authors' Contributions

Maria Mazhar: Conceptualization, Methodology, Software: **Muhammad Tariq Majeed:** Supervision Data curation, Methodology: **Saira Tufail:** Visualization, Writing- Reviewing and Editing.

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