Exploring the Symmetric and Asymmetric Impact of Air Transport, Financial Development on Economic Growth in South Korea

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Abstract

This study examines the symmetric and asymmetric effects of air transport and financial development on economic growth in South Korea. Both the linear Autoregressive Distributed Lag (ARDL) model and the nonlinear Autoregressive Distributed Lag (NARDL) model are employed using annual data spanning the period 1980–2023. The cointegration results obtained from both the ARDL bounds test and the NARDL bounds test confirm the existence of a long-run equilibrium relationship among the study variables. The ARDL estimations designate that air transport and financial development exert a negative and statistically significant effect on economic growth in both the short and long run. In contrast, the NARDL results reveal significant asymmetric effects. Specifically, positive shocks to air transport have a positive and statistically significant impact on economic growth in both the short and long run. Moreover, both positive and negative shocks to financial development significantly influence economic growth, with positive shocks promoting economic growth and negative shocks constraining it. These findings highlight the importance of accounting for nonlinear and asymmetric relationships when examining the roles of air transport and financial development in promoting economic growth.

Keywords: air transport, financial development, economic growth, ARDL, NARDL, South Korea.

Jel: C10; C30; E43; L83

Introduction

The air transport sector is a vital and effective component of the modern transport system, given its pivotal role in supporting economic development and promoting trade and investment between countries. In recent decades, this sector has witnessed remarkable global expansion, driven by increasing globalization and the growing interconnectedness and integration of national economies. This has contributed to increased demand for air transport services and solidified its position as a strategic sector supporting economic growth and international connectivity. As a result, many countries have invested heavily in modernizing airport infrastructure, expanding airline networks, and improving tourism services to enhance their international competitiveness.

Currently, the aviation sector has become an essential pillar of the tourism industry, facilitating international travel and strengthening trade, investment, and cultural exchange. Developments in tourism infrastructure have stimulated the growth of aviation, while increased competition among tourist destinations has encouraged countries to offer competitive airfares and high-quality aviation services supported by advanced technologies. Therefore, aviation has emerged as a key driver of sustainable economic development by improving connectivity, expanding market access, and promoting international trade associated with tourism (Thrane, 2015; Njoya, 2020).

Beyond its direct contribution to transportation, the aviation industry creates substantial economic and social benefits. It enhances the balance of payments by increasing foreign exchange earnings through tourism and international business activities, creates employment opportunities, and promotes technological innovation. Furthermore, exposure to international competition encourages more efficient allocation of economic resources, while improved connectivity facilitates knowledge transfer, business expansion, and regional integration. From a social perspective, the aviation sector strengthens interactions among people and cultures while promoting compliance with international standards and regulations that improve service quality and operational safety (Han et al., 2020).

The economic contribution of aviation extends through direct, indirect, and induced effects. Direct effects include employment and value creation generated by airlines, airports, aircraft maintenance organizations, air traffic management, aviation regulatory bodies, and passenger services such as check-in, baggage handling, catering, and onboard retail. These effects also encompass the activities of aerospace manufacturers that produce aircraft and aviation equipment (Vasigh & Pearce, 2024). Indirect effects arise from the aviation supply chain, including fuel suppliers, construction companies, aircraft component manufacturers, information technology providers, financial services, and other business support industries. Induced effects result from the spending of employees working directly or indirectly in aviation, thereby stimulating demand across retail, manufacturing, banking, hospitality, and other service industries (Button, 2022).

The global economic significance of aviation continues to increase. According to the Air Transport Action Group (ATAG, 2025), the aviation sector supported approximately 86.5

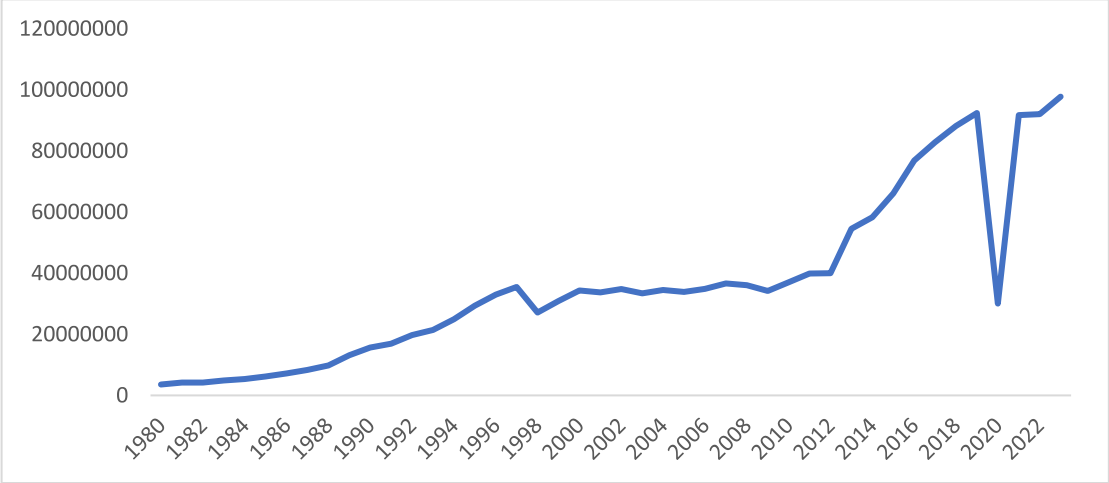
million jobs worldwide in 2023. During the same year, airlines transported around 4.4 billion passengers, including 1.8 billion international travelers and 2.6 billion domestic passengers. The industry's total contribution to the global economy reached approximately USD 4.1 trillion in 2023 and is projected to expand to USD 8.5 trillion by 2043, highlighting aviation's growing importance as a catalyst for long-term economic growth.

South Korea represents one of Asia's leading aviation markets and provides an important case for examining the relationship between aviation and economic performance. According to the World Travel & Tourism Council (WTTC, 2025), approximately 108,200 people are employed directly in South Korea's aviation industry, generating USD 19.1 billion in economic output, equivalent to 1.1% of national GDP. When indirect, induced, and tourism-related effects are considered, aviation contributes approximately USD 78.1 billion to GDP and supports around 1.2 million jobs. Aviation-related tourism alone contributes an estimated USD 21.2 billion to GDP while supporting approximately 437,700 jobs. In addition, international visitors to South Korea spend nearly USD 18.6 billion annually on goods and services, further demonstrating the aviation sector's substantial contribution to national economic activity.

South Korea has experienced remarkable growth in air transport over the past four decades. The number of air passengers increased from approximately 3.5 million in 1980 to 92.5 million in 2019, reflecting rapid expansion in aviation demand and infrastructure development. Although passenger traffic declined sharply during the COVID-19 pandemic due to international travel restrictions, the sector recovered steadily following the easing of restrictions and has returned to its long-term growth trajectory. Figure 1 illustrates the evolution of air passenger transport in South Korea over the period 1980–2023.

Despite the growing importance of aviation for economic development, empirical evidence regarding its impact remains inconclusive. While several studies report that improvements in air transport stimulate economic growth by enhancing connectivity, tourism, trade, and investment, others find weaker or nonlinear relationships depending on countries' institutional and financial conditions. Furthermore, previous studies have largely relied on symmetric econometric models, which assume that increases and decreases in aviation activity have identical effects on economic growth. Such an assumption may overlook important asymmetric responses arising from economic shocks, financial crises, or disruptions such as the COVID-19 pandemic.

Against this background, the present study examines both the symmetric and asymmetric effects of air transport and financial development on economic growth in South Korea using the Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) approaches. By incorporating energy consumption, social globalization, and urbanization as control variables, the study provides a comprehensive assessment of the long-run and short-run dynamics among these variables. The findings contribute to the growing literature on aviation economics by demonstrating whether positive and negative changes in air transport and financial development affect economic growth differently, thereby offering valuable policy implications for sustainable economic development in South Korea.



Source: World Bank.

FIGURE 1

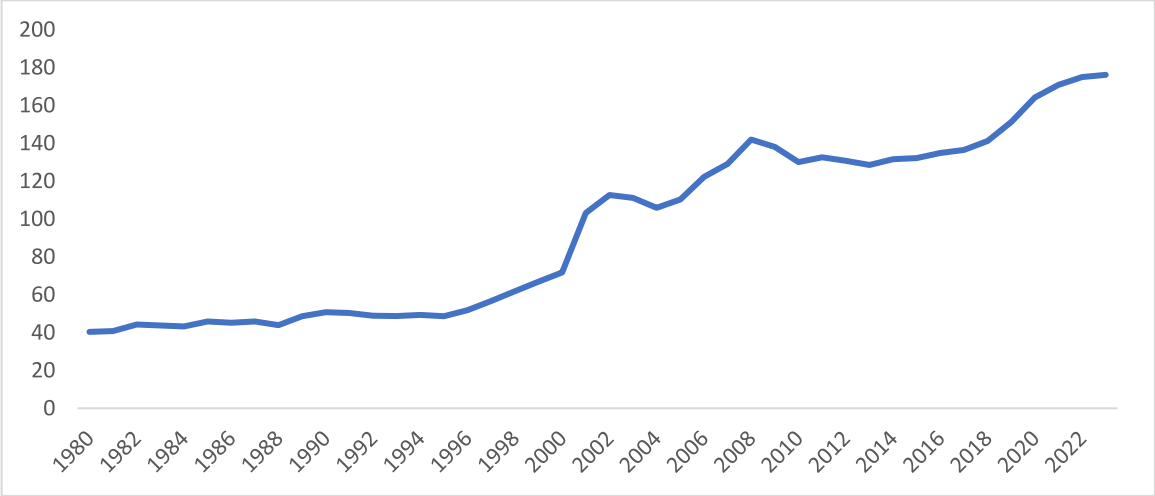
AIR TRANSPORT TREND IN SOUTH KOREA FROM 1980-2023

Financial development is widely recognized as one of the fundamental drivers of economic activity and long-term economic growth. Financial institutions perform essential functions in modern economies by mobilizing savings, allocating financial resources, facilitating investment, and providing credit to industrial, commercial, and service sectors. Therefore, the efficiency and depth of the financial system represent important determinants of economic performance. In advanced economies, financial sector development has contributed to the emergence of innovative financial instruments, improved risk management mechanisms, and enhanced access to financing, thereby supporting productivity and economic expansion.

The importance of financial development is reflected in the high level of domestic credit provided to the private sector worldwide. In 2023, domestic credit to the private sector averaged approximately 142% of GDP globally, highlighting the significant role of financial intermediaries in supporting economic activities. South Korea represents one of the notable examples of rapid financial deepening. The ratio of domestic credit to the private sector increased from 40.4% of GDP in 1980 to approximately 176% in 2023. This level exceeds that of several advanced economies, including Italy (63.5%), Germany (77.9%), France (112.7%), and the United Kingdom (119.4%).

The substantial expansion of private sector credit in South Korea reflects the close relationship between financial sector development and economic transformation, particularly during the country's rapid industrialization and export-oriented growth process. However, the relationship between financial development and economic growth is not necessarily linear. While increased credit availability can stimulate investment, innovation, and productivity, excessive credit expansion may also create financial vulnerabilities, inefficient resource

allocation, and instability. Therefore, examining both positive and negative shocks to financial development is essential for understanding its actual impact on economic growth. Figure 2 illustrates the evolution of financial development in South Korea during the period 1980–2023.



Source: World Bank.

FIGURE 2

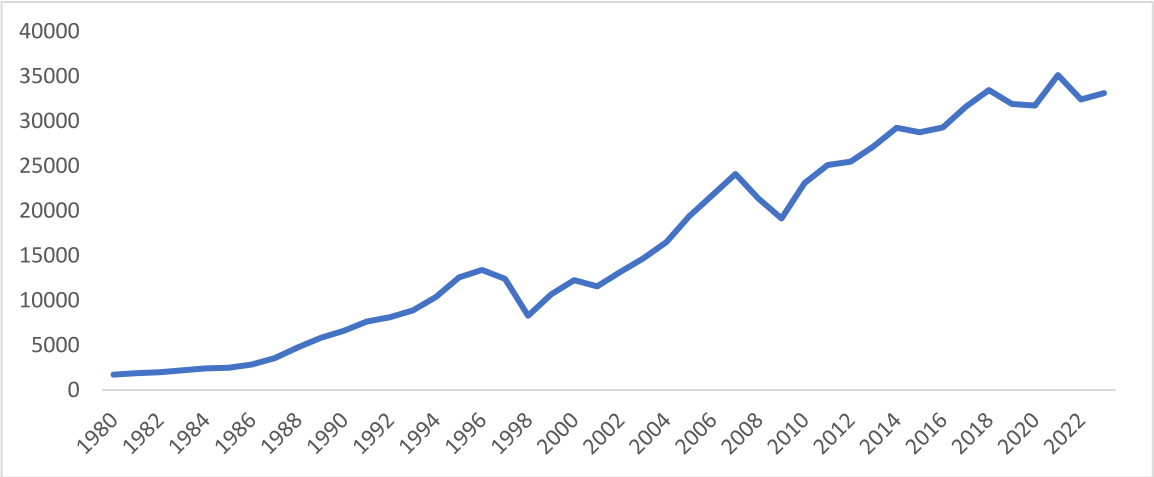
FINANCIAL DEVELOPMENT TREND IN SOUTH KOREA FROM 1980-2023

South Korea has achieved remarkable economic transformation and sustained economic growth over the past four decades. The country's development experience has been largely shaped by industrialization strategies, export-oriented growth policies, investment in human capital, and effective economic planning. These strategies played a significant role in transforming South Korea from a relatively low-income economy into an advanced industrialized economy within a relatively short period.

In 1980, South Korea's GDP per capita was approximately USD 1,715. Following the implementation of successive industrial development plans and export promotion strategies, income levels increased substantially despite facing various domestic and external challenges, including global economic fluctuations and financial crises. Through a combination of sound macroeconomic management, institutional development, technological advancement, and effective public governance, South Korea achieved remarkable improvements in economic performance. By 2023, GDP per capita had reached approximately USD 33,121, reflecting the country's successful structural transformation and integration into the global economy.

This sustained economic progress has been accompanied by significant development across various sectors, including manufacturing, technology, financial services, trade, and transportation. The South Korean experience demonstrates the importance of coordinated economic policies and productive investment in supporting long-term economic growth.

Figure 3 illustrates the evolution of GDP per capita in South Korea during the period 1980–2023.



Source: World Bank.

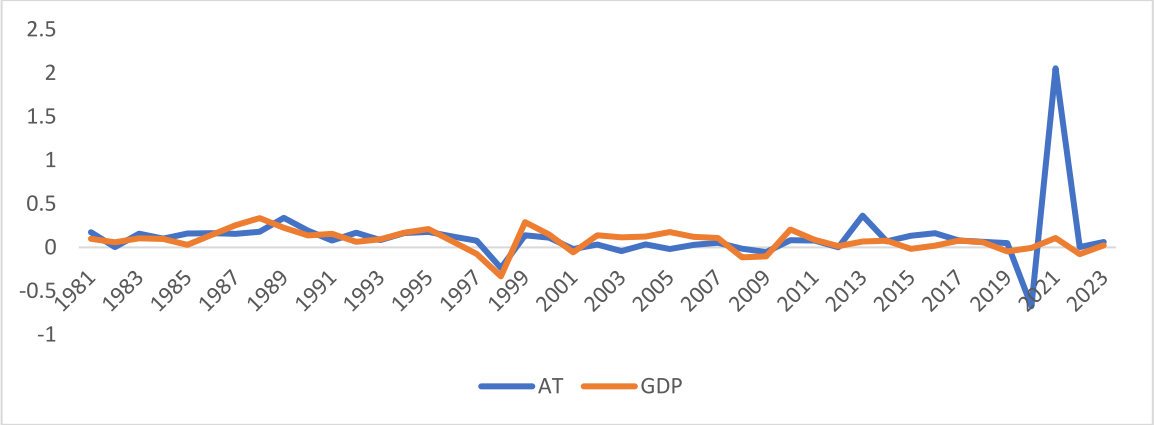
FIGURE 3

GDP PER CAPITA TREND IN SOUTH KOREA FROM 1980-2023

South Korea's economic performance during the period 1981–2023 was characterized by sustained growth despite experiencing several internal and external shocks. One of the most significant challenges was the Asian financial crisis of 1997–1998, which adversely affected many economies in the region. Nevertheless, the South Korean economy demonstrated considerable resilience and maintained its long-term growth trajectory through structural reforms, technological advancement, and effective economic management.

This economic expansion was reflected across various sectors, including the air transport industry, which experienced substantial development over the past decades. The aviation sector benefited from increasing international integration, rising income levels, trade expansion, and growing tourism activities. Although the COVID-19 pandemic caused an unprecedented disruption to global air transport by reducing passenger demand and restricting international mobility, the sector recovered significantly after the removal of travel restrictions. This rapid recovery highlights the resilience and adaptability of South Korea's aviation industry.

Figure 4 presents the growth trends of air transport and GDP per capita in South Korea during the period 1981–2023, illustrating the dynamic relationship between aviation development and overall economic performance.



Source: World Bank.

FIGURE 4

GDP PER CAPITA AND AIR TRANSPORT GROWTH RATE IN SOUTH KOREA FROM 1981-2023

Finally, it is important to highlight the apparent divergence between economic growth and financial development dynamics in South Korea during the period 1981–2023. Although financial development generally expanded alongside economic transformation, several episodes indicate that changes in domestic credit to the private sector did not always move in the same direction as economic growth. For instance, in 1988, economic growth experienced a substantial increase, while domestic credit to the private sector recorded a notable decline. Similarly, in 1998, GDP growth declined significantly following the Asian financial crisis, whereas the growth rate of domestic credit remained relatively stable. In 2001, economic growth decreased, while domestic credit to the private sector increased by approximately 44%.

These observations suggest that the relationship between financial development and economic growth in South Korea may not be linear or symmetric. In particular, expansions and contractions in credit availability may generate different economic responses depending on prevailing economic conditions, financial stability, and the efficiency of credit allocation. Therefore, the existence of positive and negative financial development shocks provides motivation for applying the NARDL approach, which allows the asymmetric effects of financial development on economic growth to be examined.

Figure 5 illustrates the evolution of GDP per capita growth and financial development growth in South Korea during the period 1981–2023.

Source: World Bank.

FIGURE 5

GDP PER CAPITA AND FINANCIAL DEVELOPMENT GROWTH RATE IN SOUTH KOREA FROM 1981-2023

Literature Review

The relationship between air transport, financial development, and economic growth has received increasing attention in the economics and transportation literature. The rapid expansion of the aviation industry over recent decades, driven by globalization, trade liberalization, and the liberalization of air transport markets, has strengthened the role of aviation as a catalyst for tourism, trade, foreign investment, and regional integration. At the same time, advances in financial systems and digital technologies have facilitated air travel by improving payment systems, expanding access to financial services, and reducing transaction costs. Consequently, both air transport and financial development have become important determinants of economic performance.

Several studies have examined the contribution of air transport to economic growth using nonlinear econometric approaches. Khanal et al. (2022) investigated the Air-Transportation-Led Growth Hypothesis (ALGH) in Australia using annual data from 1971–2019 and the nonlinear autoregressive distributed lag (NARDL) model. Their findings confirmed significant asymmetric effects in both the short and long run, demonstrating that positive shocks in air transport stimulate economic growth, whereas negative shocks exert a considerably larger adverse effect.

Similarly, Balsalobre-Lorente et al. (2020) examined the Spanish economy using the NARDL framework and reported that air transport, social globalization, and urbanization significantly promote economic growth. Their results indicated that positive changes in air transport

generate substantial long-run improvements in GDP, highlighting the importance of aviation as an engine of economic expansion.

Evidence from tourism-related studies also supports the existence of nonlinear relationships. Garrod et al. (2023), using annual data for a small island economy over the period 1976–2019, found that tourism positively contributes to economic growth; however, the relationship is asymmetric, with negative tourism shocks exerting considerably stronger effects than positive shocks. These findings suggest that transportation and tourism sectors respond differently to positive and negative economic disturbances.

The relationship between financial development and economic growth has also generated extensive empirical debate. Liu and Hsu (2006) analyzed Taiwan, South Korea, and Japan using the Generalized Method of Moments (GMM) and Principal Component Analysis (PCA). Their results revealed that financial development positively affected Taiwan's economic growth but negatively influenced South Korea and Japan. Moreover, capital outflows following financial liberalization adversely affected all three economies.

Using nonlinear techniques, Al-Khatib et al. (2023) investigated the relationship between financial development and economic growth in Algeria during 1980–2020. Applying Transfer Entropy, NARDL, and the Cumulative Dynamic Multiplier approach, the study concluded that financial development affects economic growth asymmetrically in both the short and long run, with positive and negative financial shocks producing significantly different responses.

Other studies report mixed evidence regarding the finance-growth nexus. Liang and Jian-Zhou (2006) found no significant relationship between financial development and GDP in China, while Yucel (2009) reported that financial development negatively affected economic growth in Türkiye, although trade openness promoted growth. Likewise, Kaushal and Pathak (2015) concluded that financial development did not significantly influence India's economic growth despite evidence of short-run interactions among GDP, trade openness, and financial variables.

Conversely, several studies document positive effects of financial development on economic performance. Rahman et al. (2015) identified a stable long-run relationship among financial development, international trade, and economic growth in Australia. Adamopoulos (2013) found evidence of long-run causality between financial development and economic growth in Ireland, while Akinci et al. (2014) reported long-run cointegration between financial development and economic growth across OECD countries.

Nevertheless, not all studies support a positive finance-growth relationship. Leitão (2012), using a dynamic panel System-GMM estimator for EU-27 countries, concluded that excessive domestic credit may reduce economic growth by weakening banking sector stability. These findings suggest that the impact of financial development depends on institutional quality, financial efficiency, and the productive allocation of financial resources.

Overall, previous empirical evidence remains inconclusive. While many studies report positive effects of aviation and financial development on economic growth, others identify insignificant or even negative relationships. More importantly, most previous research has examined air transport and financial development separately or has relied on conventional symmetric models that assume identical responses to positive and negative shocks.

To the best of the authors' knowledge, limited empirical evidence simultaneously investigates the asymmetric effects of air transport and financial development on economic growth in South Korea using the NARDL framework. This study addresses this gap by examining both symmetric and asymmetric relationships while controlling for energy consumption, social globalization, and urbanization. Consequently, the study contributes to the literature by providing new evidence on whether positive and negative changes in aviation activity and financial development exert different impacts on economic growth.

Model Specification and Methodology

Model Specification

Economic growth is influenced by numerous macroeconomic and structural factors, particularly in highly open economies that are increasingly integrated into global markets. South Korea represents an ideal case study because its economy relies heavily on international trade, advanced financial markets, and one of the world's most developed aviation networks. Given the strong interdependence between aviation, tourism, financial services, and international commerce, fluctuations in air transport activity and financial development are expected to influence economic performance through multiple transmission channels.

The aviation sector is highly sensitive to economic cycles, geopolitical events, financial crises, pandemics, and other external shocks. Likewise, financial development plays a crucial role in mobilizing savings, allocating capital efficiently, facilitating investment, and supporting productive economic activities. However, positive and negative changes in financial conditions do not necessarily affect economic growth symmetrically. Consequently, estimating only linear relationships may conceal important nonlinear dynamics.

To capture both symmetric and asymmetric effects, this study employs the linear Autoregressive Distributed Lag (ARDL) model developed by Pesaran et al. (2001) together with the Nonlinear Autoregressive Distributed Lag (NARDL) model proposed by Shin et al. (2014). The ARDL model estimates the average long-run and short-run relationships among the variables, whereas the NARDL framework decomposes changes in air transport and financial development into positive and negative partial sums, thereby allowing separate estimation of expansionary and contractionary effects.

Following the approaches adopted by Balsalobre-Lorente et al. (2020), Khanal et al. (2022), Raihan et al. (2024), and Shin et al. (2014), the empirical model is specified to examine the effects of air transport and financial development on economic growth while controlling for

energy consumption, social globalization, and urbanization. This specification enables a comprehensive assessment of both the long-run equilibrium relationship and the short-run adjustment dynamics among the variables.

$$GDP = f(AT, FD, X) \quad (1)$$

Where, GDP: GDP Per Capita proxy of Economic growth; AT: air Passenger carried;
FD: financial development (Domestic credit to private sector % GDP); X : control variables include EU: energy consumption per capita; SG: Social globalization index; UR: Urban % of population.
By taking natural logarithm form equation

$$LGDP_t = \beta_0 + \beta_1 LAT_t + \beta_2 LEU_t + \beta_3 LFD_t + \beta_4 LSG_t + \beta_5 LU_t + \varepsilon_t \quad (2)$$

In this study, empirical specification is an econometric representation of the linear and non-linear relationship between AT, FD, EU, SG, UR and GDP per capita in the context of short-run and long-run dynamics.

B. Methodology

In this context, ARDL bounds test approach was used to estimate the symmetric the long-run and short-run relationship between the AT, FD, EU, SG, UR and GDP per capita. Based on Equation (3), the ARDL model estimates the effect of independent variables on the GDP per capita growth rate within the framework of short-run and long-run dynamics as follows:

$$\Delta LGDP_t = \beta_0 + \beta_1 GDP_{t-1} + \beta_2 LAT_{t-1} + \beta_3 LEU_{t-1} + \beta_4 LFD_{t-1} + \beta_5 LSG_{t-1} + \beta_6 LU_{t-1} + \sum_{i=1}^{q} \gamma_1 \Delta GDP_{t-i} + \sum_{i=1}^{q} \gamma_2 \Delta LAT_{t-i} + \sum_{i=1}^{q} \gamma_3 \Delta LEU_{t-i} + \sum_{i=1}^{q} \gamma_4 L\Delta FD_{t-i} + \sum_{i=1}^{q} \gamma_5 \Delta LSG_{t-i} + \sum_{i=1}^{q} \gamma_6 \Delta LUR_{t-i} + \theta ECM_{i-1} + \varepsilon_t \quad (3)$$

Where q representing the lag length of the series, Δ as the first difference operator, and θ as the coefficient of the ECM. $\beta_1 - \beta_6$ represent the long run coefficients, $\gamma_1 - \gamma_6$ represent the short run coefficients.

To investigate the positive and negative shock in air transport, financial development and its impacts on economic growth, the nonlinear autoregressive distributed lag (NARDL) methodology is considered as a brilliant econometric estimation technique for discovering the asymmetric impacts. Several reasons support employing the NARDL method, specifically its usefulness in capturing the intricate dynamics that define these economic connections. The

main validation for utilizing the NARDL method lies in its ability to discover asymmetric relationships that traditional linear models may struggle to adequately illustrate, as these conventional models assume uniform responses to changes in independent variables. In contrast, the NARDL method simplifies separate estimation of both positive and negative shocks, allowing for a more nuanced understanding of how economic variables respond to both increases and decreases in growth interventions. Furthermore, a notable advantage of employing the NARDL framework is its ability to model short-term dynamics alongside long-term associations within a single framework. This feature allows for a comprehensive examination of both immediate and enduring effects, providing a holistic view of the temporal dynamics of economic growth. Furthermore, the NARDL approach excels at addressing the nonlinearities found in economic relationships. Given the observed nonlinear effects, a modeling technique capable of accommodating the complexities in the interactions among air transport passengers, financial development, and economic growth is essential. The NARDL model's capacity to integrate nonlinear changes confirms a more accurate and realistic portrayal of these relationships, thereby filling a gap often neglected in linear analyses. Lastly, the NARDL method's significance is further improved by its robustness to the integration properties of variables. As noted by Shin *et al.* (2014), equation (2) can be reformulated within the NARDL framework as follows:

$$LnGDP_t = a_0 + a_1 LnAT_t^{+} + a_2 LnAT_t^{-} + a_3 LnFD_t^{+} + a_4 LnFD_t^{-} + a_5 LnEU_t + \\ + a_6 LnSG_t + a_7 LnUR_t + \varepsilon_t \qquad (4)$$

In order to examine the positive and negative shock impact of AT and FD on economic growth, the changes in the partial sum can be portrayed as follow:

$$AT^{+}{}_t = \sum_{i=1}^{t} \Delta AT_i^{+} = \sum_{i=1}^{t} \max(\Delta AT_{i,}\ 0) \qquad \text{Positive shock} \qquad (5)$$

$$AT^{-}{}_t = \sum_{i=1}^{t} \Delta AT_i^{-} = \sum_{i=1}^{t} \min(\Delta AT_{i,}\ 0) \qquad \text{negative shock} \qquad (6)$$

$$FD_t^{+} = \sum_{i=1}^{t} \Delta FD_i^{+} = \sum_{i=1}^{t} \max(\Delta FD_{i,}\ 0) \qquad \text{positive shock} \qquad (7)$$

$$FD_t^{-} = \sum_{i=1}^{t} \Delta FD_i^{-} = \sum_{i=1}^{t} \min(\Delta FD_{i,}\ 0) \qquad \text{negative shock} \qquad (8)$$

The NARDL model is utilized to explore how fluctuations in shocks, including both positive and negative changes in independent variables, impact time-series dependent variables (Neog and Yadava, 2020). Due to its accurate and reliable outcomes when the variables are in level I(0),

first difference I(1), or a combination of I(0) and I(1), NARDL is a commonly applied technique. It also differentiates between the short-run and long-run impacts of independent variables on the dependent variable. According to the critical bounds established by Pesaran *et al.* (2001), a long-term relationship among the variables is identified when the calculated F-statistics exceed the upper bound's critical value at a 5% significance level. By integrating equations 5, 6, 7, and 8 adhering to the econometric methodology of Shin et al. (2014) and Villanthenkodath *et al.* (2021), we formulate the NARDL estimates for both long-run and short-run effects as outlined:

$$\Delta lnGDP_t = \beta_0 + \beta_1 lnGDP_{t-1} + \beta_2 lnAT^+{}_{t-1} + \beta_3 lnAT^-{}_{t-1} + \beta_4 lnFD^+{}_{t-1} + \beta_5 lnFD^-{}_{t-1} + \beta_6 lnEU_{t-1} + \beta_7 lnSG_{t-1} + \beta_8 lnUR_{t-1} + \sum_{i=1}^{j} \delta_1 \Delta lnGDP_{t-i} + \sum_{i=0}^{k} (\delta_2^+ \Delta lnAT_i{}^+ + \delta_3^- \Delta lnAT_i{}^-) + \sum_{i=0}^{m} (\delta_4^+ \Delta lnAFD_i{}^+ + \delta_5^- \Delta lnFD_i{}^-) + \sum_{i=0}^{n} \delta_6 \Delta lnEU_{t-i} + \sum_{i=0}^{L} \delta_7 \Delta lnSG_{t-i} + \sum_{i=0}^{o} \delta_8 \Delta lnUR_{t-i} + \varphi ECM_{t-1} + \varepsilon_t \quad (9)$$

Where, $\beta_1 - \beta_8$ long run impacts, $\alpha_1 - \alpha_7$ long run impacts as mentioned in equation 4, $\alpha_1 - \beta_2/\beta_1$; $\alpha_2 = -\beta_3/\beta_1$ displays the long run impacts of positive and negative shoch in the air transportation on economic growth, $\alpha_4 - \beta_4/\beta_1$; $\alpha_5 = -\beta_5/\beta_1$ presents the long run impacts of positive and negative shoch in the financial development on economic growth, $j, k, m, n, l, o\ are\ lag$ orders, $\delta_1 - \delta_8$ short run impacts, $\sum_{i=0}^{k} \delta_2^+$ measure the impact of an increase in air transportation on economic growth in the short term, $\sum_{i=0}^{k} \delta_3^-$ measure the impact of a decrease in air transportation on economic growth in the short term. $\sum_{i=0}^{m} \delta_4^+$ measure the impact of an increase in financial development on economic growth in the short term, $\sum_{i=0}^{m} \delta_5^-$ measure the impact of a decrease in financial development on economic growth in the short term. Δdenotes difference operator; and ε_t is the white noise term.

The impact of dynamic asymmetric multiplier on the variables can be stated as follows:

$$m(AT)_h^+ = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{AT_{t-1}^+} = m(AT)_h^- = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{AT_{t-1}^-}, h = 0,1,2 \ldots \quad (10)$$

$$m(FD)_h^+ = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{FD_{t-1}^+} = m(FD)_h^- = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{FD_{t-1}^-}, h = 0,1,2 \ldots \quad (11)$$

Kowing that, as $h \to \infty, m(AT)_h^+ \to a_1,\ and\ m(AT)_h^- \to a_2$.

$$m(FD)_h^+ \to a_3,\ and\ m(FD)_h^- \to a_4.$$

The dynamic multiplier approach enables the examination of how the endogenous variable responds differently to positive and negative changes in the explanatory variables. Following a shock to the system, the estimated multipliers trace the adjustment path of the dependent variable from the initial equilibrium toward the new long-run equilibrium. Consequently, the dynamic multiplier analysis provides a comprehensive illustration of both the magnitude and speed of adjustment associated with positive and negative shocks, thereby offering valuable insights into the asymmetric transmission mechanism captured by the NARDL model.

Data

This study employs annual time-series data for South Korea covering the period 1980–2023. Real GDP per capita, air transport (measured by passengers carried), financial development, energy consumption per capita, and urbanization were obtained from the World Development Indicators (WDI) database. Data on the Social Globalization Index were collected from the KOF Swiss Economic Institute, whose Globalization Index measures the economic, social, and political dimensions of globalization (KOF, 2023).

Before conducting the econometric analysis, descriptive statistics were examined to understand the characteristics and distribution of the variables. Table 1 presents the descriptive statistics for all variables included in the analysis. The results indicate relatively low standard deviations for all variables, suggesting limited dispersion around their respective means and indicating stable time-series behavior over the sample period. The Jarque–Bera normality test reveals that most variables are normally distributed, with the exception of lnEU and lnUR, which deviate from normality. Nevertheless, the ARDL and NARDL approaches are robust to moderate departures from normality and therefore remain appropriate for the present analysis.

Furthermore, the correlation matrix indicates positive pairwise associations between economic growth and the explanatory variables, including air transport, financial development, energy consumption, urbanization, and the Social Globalization Index. These positive correlations provide preliminary evidence of potential long-run relationships among the variables; however, correlation alone does not imply causality. Consequently, further econometric procedures, including unit root testing, cointegration analysis, and ARDL/NARDL estimation, are employed to establish the existence and direction of both short-run and long-run relationships.

TABLE 1

DESCRIPTIVE STATISTICS

	LGDP	LAT	LFD	LSG	LEU	LUR
Mean	9.372	17.081	4.420	4.200	10.575	4.333
Median	9.494	17.336	4.650	4.259	10.816	4.384
Maximum	10.467	18.398	5.171	4.392	11.133	4.406
Minimum	7.447	15.087	3.698	3.884	9.384	4.038
Std. Dev.	0.936	0.928	0.526	0.164	0.586	0.104
Skewness	-0.708	-0.653	-0.065	-0.534	-0.892	-1.538
Kurtosis	2.293	2.570	1.282	1.909	2.344	4.098
Jarque-Bera	4.591	3.462	5.445	4.269	6.625	19.554
Probability	0.101	0.177	0.066	0.118	0.036	0.000
			Correlation			
LGDP	1.000					
LAT	0.959	1.000				
LFD	0.898	0.827	1.000			
LSG	0.983	0.951	0.941	1.000		
LEU	0.984	0.961	0.885	0.983	1.000	
LUR	0.937	0.930	0.766	0.911	0.961	1.000

Empirical results

Before conducting the cointegration analysis, it is necessary to examine the stationarity properties of the variables through unit root tests. This preliminary step is essential because the validity of the ARDL and NARDL approaches depends on ensuring that none of the

variables are integrated of order two, I(2). Furthermore, identifying the order of integration helps determine the appropriate econometric methodology for investigating the long-run relationships among the variables.

In this study, three-unit root tests were employed: the Augmented Dickey–Fuller (ADF) test, the Dickey–Fuller Generalized Least Squares (DF–GLS) test, and the Phillips–Perron (PP) test. As reported in Table 2, the results indicate that all variables are stationary either at their levels, I(0), or after taking the first difference, I(1). Since none of the variables exhibit integration of order two, the results confirm that the dataset satisfies the necessary conditions for applying the ARDL and NARDL cointegration approaches.

TABLE 2

THE RESULTS OF UNIT ROOT TESTS

	ADF		DF-GLS		PP	
	At level	First difference	At level	First difference	At level	First difference
L(GDP)	-2.417	-5.241***	0.397	-4.125***	-2.541	-5.241***
L(AT)	-1.721	-9.937***	-1.024	-10.218***	-1.899	-10.083***
L(FD)	-0.585	-4.801***	-1.011	-4.087***	-0.388	-4.740***
L(EU)	-4.148***	-3.804***	-0.910	-5.705***	-3.488**	-3.998***
L(UR)	-3.716***	-1.934	-1.158	-1.978**	-9.943***	-2.059
L(SG)	-2.399	-6.770***	0.866	-5.786***	-2.698*	-6.768***

*, ** and ***, 1%, 5% and 10%

Table 3 reports the results of the cointegration tests used to examine the existence of a long-run relationship among the study variables. According to the ARDL bounds testing approach, cointegration exists when the calculated F-statistic exceeds the upper critical bound value, leading to the rejection of the null hypothesis of no long-run relationship. The results indicate that the F-statistics obtained from both the ARDL and NARDL models are higher than the corresponding critical values, confirming the existence of cointegration among air transport, financial development, energy consumption, urbanization, the Social Globalization Index, and economic growth.

These findings suggest that the variables move together in the long run and that temporary deviations from equilibrium are corrected over time. Therefore, the ARDL and NARDL estimation frameworks are appropriate for analyzing both the symmetric and asymmetric

short-run and long-run effects of air transport and financial development on economic growth in South Korea.

TABLE 3

ARDL and NARDL BOUNDS TESTs

Null hypothesis: No degree of relationship					
ARDL bound Test result					
Test Statistic	Value	Significant level	I(0)	I(1)	Result
F	4.826	10%	2.08	3	Cointegrated
K	5	5%	2.39	3.38	
		2.5%	2.7	3.73	
		1%	3.06	4.15	
NARDL bound Test result					
Test Statistic	Value	Significant level	I(0)	I(1)	
F	4.707	10%	1.92	2.89	Cointegrated
K	7	5%	2.17	3.21	
		2.5%	2.43	3.51	
		1%	2.73	3.9	

*, ** and ***, 1%, 5% and 10%

Long Run ARDL And NARDL Results

After confirming the existence of a long-run relationship among the variables through the ARDL and NARDL bounds testing approaches, the ARDL model was employed to estimate the symmetric short-run and long-run effects among the study variables. Subsequently, the NARDL model was applied to examine whether positive and negative changes in air transport and financial development generate asymmetric effects on economic growth in both the short and long run.

Tables 4 and 5 present the estimation results of the linear ARDL and nonlinear NARDL models, respectively, for South Korea over the period 1980–2023. These models provide evidence on the magnitude, direction, and statistical significance of the symmetric and asymmetric relationships between air transport, financial development, and economic growth, while controlling for energy consumption, urbanization, and social globalization.

TABLE 4

LONG-RUN ESTIMATIONS OF THE ARDL AND NARDL MODELS

ARDL				NARDL			
Variable	Coeff.	t-Statistics	p-values	Variable	Coeff.	t-Statistics	p-values
L (AT)	-0.2107	-0.528	0.6019	LAT_POS	0.3028	2.462	0.0210**
				LAT_NEG	0.1522	1.048	0.3045
L (FD)	-0.7742	-1.2916	0.2079	LFD_POS	0.4381	2.046	0.0514*
				LFD_NEG	-2.763	-3.581	0.0014***
L (EU)	1.7532	1.0967	0.2828	LEU	0.9343	1.802	0.0837*
L (SG)	6.284	1.2534	0.2212	LSG	-4.347	-1.807	0.0827*
L (UR)	1.4616	0.3862	0.7025	LUR	2.742	1.846	0.0768*
C	-35.278	-2.2582	0.0326	C	4.396	0.548	0.5889

*, ** and ***, 1%, 5% and 10%

The ARDL estimation results indicate that, in the long run, air transport and financial development exert negative but statistically insignificant effects on economic growth. Specifically, a 1% increase in air transport is associated with a 0.21% decline in economic growth, while a 1% increase in financial development, measured by domestic credit to the private sector as a percentage of GDP, reduces economic growth by approximately 0.77%. Although these coefficients are negative, their statistical insignificance suggests that the linear relationship between air transport, financial development, and economic growth is not sufficiently strong when assuming symmetric effects. This finding highlights the possibility that positive and negative changes in these variables may generate different economic responses, which motivates the application of the nonlinear ARDL approach.

The NARDL results provide evidence of significant asymmetric effects between the explanatory variables and economic growth in South Korea. Regarding air transport, the long-run estimates indicate that positive shocks have a statistically significant and favorable effect on economic growth. A 1% increase in the positive component of air transport increases economic growth by approximately 0.30%. Interestingly, negative shocks to air transport also exhibit a positive effect, with a 1% decline in air transport associated with a 0.15% increase in

economic growth. This result suggests that reductions in air transport activity do not immediately translate into lower economic growth, possibly due to the resilience of the South Korean economy and the ability of other economic sectors to compensate for temporary declines in aviation activity.

With respect to financial development, the NARDL findings confirm the presence of asymmetric effects. Positive shocks to financial development have a significant positive impact on economic growth, where a 1% increase in financial development contributes to a 0.44% increase in economic growth. In contrast, negative shocks generate a substantially stronger adverse effect, as a 1% decrease in financial development reduces economic growth by approximately 2.70%. This asymmetric response indicates that contractions in financial development are more damaging than the benefits generated by equivalent expansions, emphasizing the critical role of financial stability and efficient credit allocation in supporting economic growth.

The control variables also provide important insights. Energy consumption has a positive and statistically significant effect on economic growth, with a 1% increase in energy consumption contributing to approximately 0.93% higher economic growth. This finding reflects the importance of energy availability in supporting industrial production and economic activities in South Korea. Similarly, urbanization demonstrates a strong positive effect, where a 1% increase in urbanization increases economic growth by approximately 2.70%, indicating that urban concentration enhances productivity, infrastructure development, and economic efficiency.

Conversely, the Social Globalization Index exhibits a negative relationship with economic growth. The results suggest that a 1% increase in social globalization reduces economic growth by approximately 4.30%. Although globalization is generally expected to enhance economic performance, this negative effect may reflect adjustment costs associated with rapid social integration, changes in consumption patterns, or possible distributional effects arising from globalization processes. Therefore, the impact of globalization may depend on institutional capacity and the ability of economies to transform globalization benefits into productive outcomes.

TABLE 5

SHORT-RUN ESTIMATIONS OF THE ARDL AND NARDL MODELS

	ARDL			NARDL		
	Coeff.	Prob.		Coeff.	t-Stat	Prob.
L(GDP(-1))	1.1746	0.0000	C	2.218	0.552	0.5855
L(GDP(-2))	-0.4378	0.0015	LGDP(-1)*	-0.505	-5.856	0.0000
L(AT)	-0.0737	0.2117	LAT_POS(-1)	0.153	2.474	0.0205**
			LAT_NEG(-1)	0.077	1.049	0.3041
L(FD)	-0.5042	0.0042***	LFD_POS(-1)	0.221	2.089	0.0470**
			LFD_NEG(-1)	-1.394	-3.086	0.0049***
L(EU)	2.019	0.0001***	LEU(-1)	0.471	1.740	0.0941*
L(SG)	1.6883	0.1017	LSG(-1)	-2.194	-1.851	0.0760*
L (UR)	18.648	0.0027***	LUR	1.384	1.835	0.0784*
DL(GDP(-1))	0.438	0.0001	D(LGDP(-1))	0.638	7.102	0.0000**
DL (AT)	-0.074	0.0432**	D(LAT_POS)	-0.018	-0.406	0.6881
			D(LAT_NEG)	-0.069	-1.546	0.1347
DL(FD)	-0.504	0.0005	D(LFD_POS)	-0.328	-2.720	0.0117**
			D(LFD_NEG)	-0.333	-0.624	0.5384
DL(EU)	2.019	0.0000	D(LEU)	1.898	10.292	0.0000***
DL(UR)	18.648		D(LEU(-1))	-1.942	-8.426	0.0000***
DL(SG)	1.688	0.0131	D(LSG)	0.661	1.062	0.2986
CointEq(-1)*	-0.2632	0.0000	CointEq(-1)*	-0.505	-7.478	0.0000***

*, ** and ***, 1%, 5% and 10%

The short-run ARDL estimation results indicate that air transport and financial development exert negative effects on economic growth in South Korea. Specifically, a 1% increase in air transport reduces economic growth by approximately 0.07%; however, this effect is statistically insignificant. In contrast, a 1% increase in financial development decreases economic growth by approximately 0.50%, and this effect is statistically significant. These findings suggest that, under the assumption of symmetric effects, expansion in financial development does not necessarily translate into immediate economic benefits, possibly due to inefficient credit allocation, excessive lending, or delays in the transmission of financial resources into productive investment activities.

However, the short-run NARDL results reveal significant asymmetric effects of air transport and financial development on economic growth. Regarding air transport, the positive and negative shocks generate different responses. A positive shock to air transport has a positive and statistically significant effect on economic growth, where a 1% increase in air transport activity increases economic growth by approximately 0.15%. Conversely, a negative shock to air transport also produces a positive effect, with a 1% decline in air transport associated with an increase in economic growth of approximately 0.08%. This result indicates that the short-run response of economic growth to changes in air transport is nonlinear, suggesting that increases and decreases in aviation activity do not have symmetric effects on the South Korean economy.

With respect to financial development, the NARDL estimates confirm the existence of asymmetric short-run effects. A positive shock to financial development has a significant positive impact on economic growth, where a 1% increase in financial development contributes to approximately 0.22% higher economic growth. In contrast, a negative shock to financial development has a substantially stronger adverse effect, as a 1% decline in financial development reduces economic growth by approximately 1.40%. This finding emphasizes that contractions in financial development impose greater economic costs than the benefits generated by equivalent expansions, highlighting the importance of maintaining financial stability and ensuring the efficient allocation of credit.

Among the control variables, energy consumption has a positive and statistically significant effect on economic growth. A 1% increase in energy consumption increases economic growth by approximately 0.47%, reflecting the importance of energy availability in supporting industrial production and economic activities. Likewise, urbanization contributes positively to economic growth, with a 1% increase in urbanization associated with a 1.38% increase in economic growth. In contrast, the Social Globalization Index has a negative short-run effect, where a 1% increase in social globalization reduces economic growth by approximately 2.19%. This result may indicate that rapid social globalization can generate short-run adjustment costs or structural pressures that temporarily reduce economic efficiency.

The asymmetry test provides a formal assessment of whether the estimated coefficients associated with positive and negative shocks are statistically different from each other. In other words, it examines whether increases and decreases in air transport and financial

development have identical effects on economic growth in both the short and long run. Rejecting the null hypothesis of symmetry confirms the presence of nonlinear relationships, indicating that economic growth responds differently to positive and negative changes in the explanatory variables. The results of the asymmetry tests are presented in Table 6.

TABLE 6

ASYMMETRY TESTS

	WLR		WSR	
	F-statistic	Prob.	F-statistic	Prob.
AT	1.841039	0.1870	29.15465	0.000
FD	2.998138	0.0957	15.93370	0.000

Table 6 presents the results of the Wald test for examining the existence of asymmetric effects in the long and short run. The probability values of the Wald test for the long-run positive and negative shocks of air transport and financial development are 0.187 and 0.095, respectively. Since these values exceed the 5% significance level, the null hypothesis of symmetry cannot be rejected. This indicates that, in the long run, positive and negative changes in air transport and financial development have statistically similar effects on economic growth in South Korea. Therefore, the long-run relationship between these variables can be considered symmetric.

In contrast, the short-run Wald test results indicate that the probability values are below the 5% significance level. Consequently, the null hypothesis of symmetry is rejected, and the alternative hypothesis of asymmetry is accepted. This finding confirms the existence of nonlinear short-run relationships, implying that positive and negative shocks to air transport and financial development do not have identical effects on economic growth. Therefore, economic growth responds differently to expansions and contractions in aviation activity and financial development in the short term.

To evaluate the reliability and stability of the estimated ARDL and NARDL models, several diagnostic tests were conducted. The results, reported in the fourth section of Table 7, confirm that the estimated models satisfy the required econometric assumptions. Specifically, the residuals do not suffer from serial correlation, non-normal distribution, heteroscedasticity, or model misspecification problems. These findings provide evidence that the estimated ARDL and NARDL specifications are statistically valid and suitable for interpreting the short-run and long-run relationships among the variables.

TABLE 7

DIAGNOSTIC TESTS

ARDL			
		F-statistic	p-values
Jarque–Bera Normality Test		0.987	0.610
Breusch-Godfrey Serial Correlation LM Test		0.377	0.690
Heteroskedasticity Test: Breusch-Pagan-Godfrey		1.029	0.459
Ramsey Reset Test		0.330	0.571
R^2	0.997	Adj. R^2	0.995
F-statistic	638.38 (***)	DW	2.026
NARDL			
		F-statistic	p-values
Jarque–Bera Normality Test		0.995	0.608
Breusch-Godfrey Serial Correlation LM Test		0.659	0.527
Heteroskedasticity Test: Breusch-Pagan-Godfrey		0.626	0.833
Ramsey Reset Test		0.400	0.533
R^2	0.997	Adj. R^2	0.996
F-statistic	643.48 (***)	DW	1.831

The CUSUM and CUSUMQ tests were employed to assess the stability of the coefficients in the ARDL and NARDL model. The results of the CUSUM and CUSUMQ tests are visually represented in Figure 6 and 7.

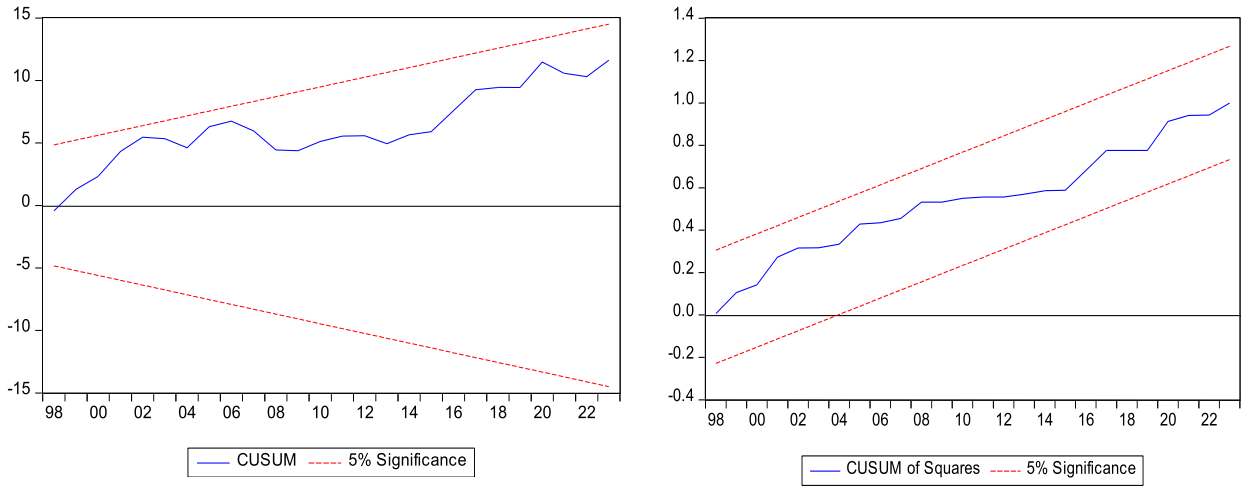


FIGURE 6

ARDL CUSUM and CUSUMQ TESTS

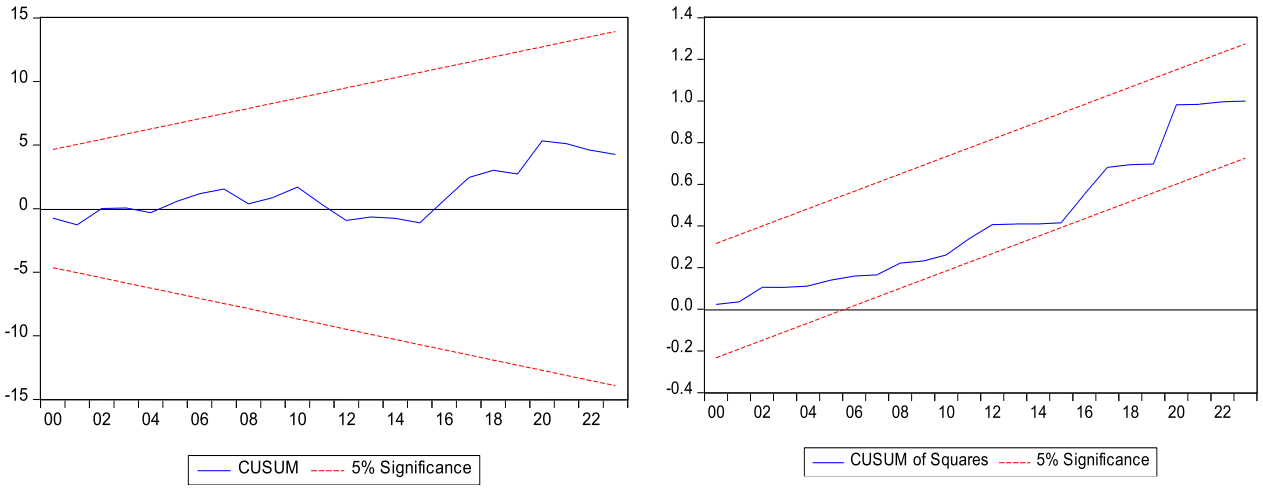


FIGURE 7

NARDL CUSUM and CUSUMQ TESTS

Figure 8 shows the asymmetric NARDL dynamic multiplier effects, which highlights the impact of both positive and negative air transport shocks on economic development. The solid black line in Figure 8 shows the positive impact of AT on GDP, whereas the dotted black line shows the negative effect of air transport on economic growth. This NARDL multiplier effects figure demonstrates the large asymmetries between the positive and negative shocks to AT and

GDP. The graph in Figure 8 illustrates the existence of a positive relationship between air transport and economic growth. The effect of a positive shock in air transport is found to dominate that of a negative shock.

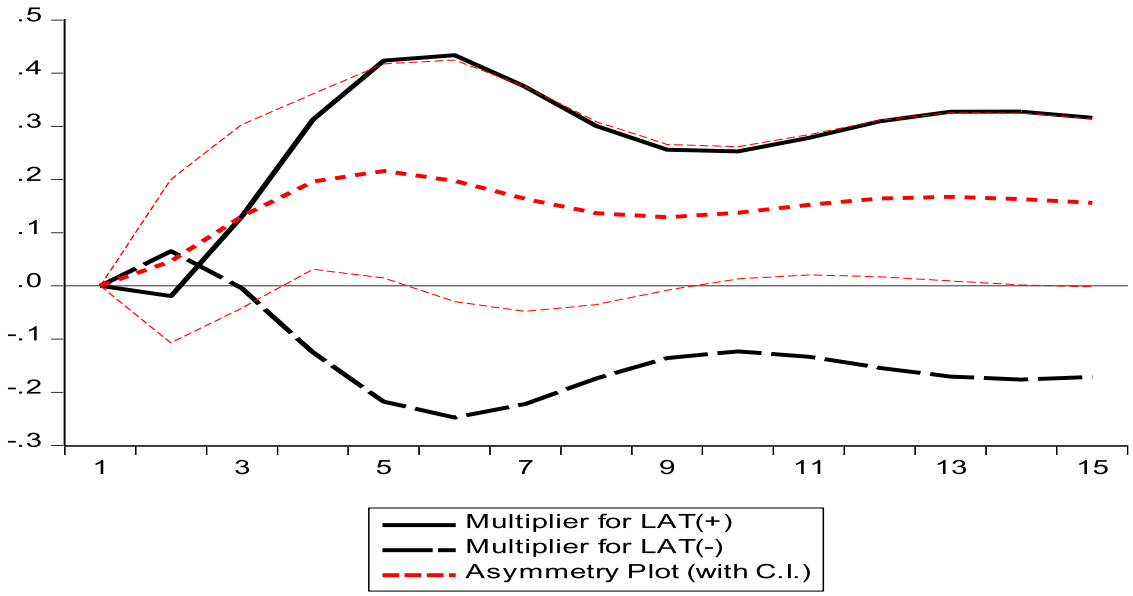


FIGURE 8

NONLINEAR AUTOREGRESSIVE DISTRIBUTED LAG MULTIPLIER GRAPH

Figure 9 shows the asymmetric NARDL dynamic multiplier effects, which demonstrates the impact of both positive and negative financial development shocks on economic development. The solid black line in Figure 9 shows the positive impact of financial development on GDP, whereas the dotted black line shows the negative effect of financial development on economic growth. This NARDL multiplier effects figure demonstrates the large asymmetries between the positive and negative shocks to AT and GDP. The graph in Figure 9 shows the existence of a negative relation between financial development and economic growth. The effect of financial development negative shock is found to dominate that of a positive shock.

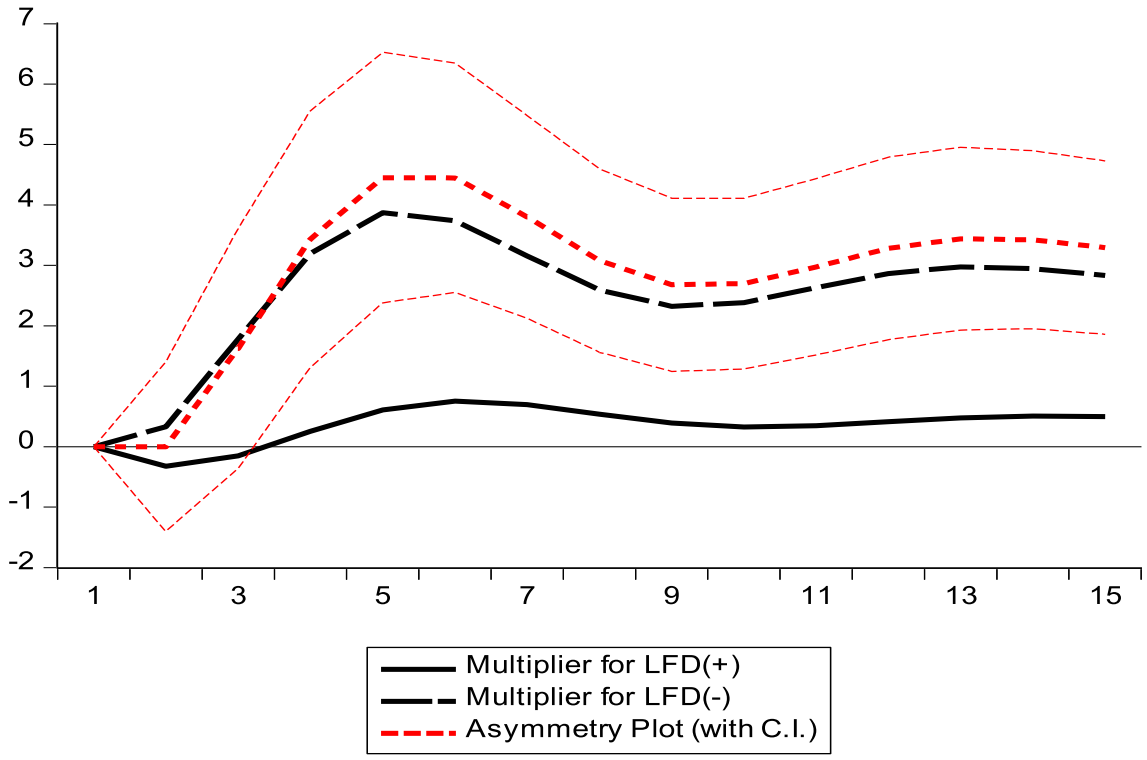


FIGURE 9

NONLINEAR AUTOREGRESSIVE DISTRIBUTED LAG MULTIPLIER GRAPH

Conclusion

This study examines the symmetric and asymmetric effects of air transport and financial development on economic growth in South Korea using the Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) approaches. Annual data covering the period 1980–2023 are employed. The cointegration results obtained from both the ARDL bounds test and NARDL framework confirm the existence of a long-run equilibrium relationship among air transport, financial development, energy consumption, social globalization, urbanization, and economic growth.

The long-run ARDL estimates indicate that air transport and financial development exert negative but statistically insignificant effects on economic growth. However, the NARDL results reveal the existence of nonlinear relationships. Positive shocks to air transport have a positive and statistically significant impact on economic growth, while negative shocks also generate a positive but statistically insignificant effect. Regarding financial development, positive shocks contribute significantly to economic growth, whereas negative shocks have a significant adverse effect. This finding confirms that expansions and contractions in financial development do not have identical consequences for economic performance in South Korea.

The short-run ARDL results show that both air transport and financial development have negative effects on economic growth, although only the negative effect of financial development is statistically significant. In contrast, the NARDL estimates demonstrate significant asymmetric responses. Positive shocks to air transport stimulate economic growth, while negative shocks produce a positive but weaker effect. Furthermore, positive shocks to financial development enhance economic growth, whereas negative shocks reduce economic growth significantly. These findings indicate that South Korea's economic performance is highly responsive to financial development shocks, particularly contractionary shocks that may restrict credit availability and investment activities.

Based on these findings, policymakers in South Korea should focus on improving the efficiency and stability of the financial system by implementing effective credit allocation policies and preventing excessive fluctuations in financial conditions. In addition, strengthening the air transport sector through infrastructure development, technological advancement, and improved connectivity can contribute to sustaining economic growth.

References

Adamopoulos, A. “Financial development and economic growth: An empirical analysis for Ireland.” I*nternational Journal of Business and Economic Sciences Applied Research 3* (No.1 2010): 75–88.

Akinci, G. Y., Akinci, M., & Yilmaz, Ö. “Financial development-economic growth nexus: a panel data analysis upon OECD countries.” *Hitotsubashi Journal of Economics 55* (No. 1 2014): 33–50.

ATAG, 2025. Supporting economic & social development, air transport action group (ATAG). Available at: https://atag.org/industry-topics/supporting-economic-social-development. (Accessed 14 April 2025).

Balsalobre-Lorente, D., Driha, O. M., Bekun, F. V., & Adedoyin, F. F. “The asymmetric impact of air transport on economic growth in Spain: Fresh evidence from the tourism-led growth hypothesis.” *Current Issues in Tourism*, *24*(No.4 2020): 503–519.

Button, K. “Transport Economics.” 4rd Edition, Edward Elgar Publishing, Inc. UK. 2022.

Garrod, B., Almeida, A., & Machado, L. “Modelling of nonlinear asymmetric effects of changes in tourism on economic growth in an autonomous small-island economy.” *European Journal of Tourism, Hospitality and Recreation 13* (No.2 2023):154–172.

Han, H., Yu, J., Lee, K. & Baek, H. “Impact of corporate social responsibilities on customer responses and brand choices.” *Journal of Travel & Tourism Marketing 37*(No.3 2020): 302–316.

Kaushal, L.A. & Pathak N. “The causal relationship among economic growth, financial development and trade openness in Indian economy.” *International Journal of Economic Perspectives 9* (No. 2 2015): 5-22.

Khanal, A., Rahman, M. M., Khanam, R., & Velayutham, E. “Exploring the Impact of Air Transport on Economic Growth: New Evidence from Australia.” *Sustainability 14* (No.18 2022), 11351.

Al-Khatib, A. M. G. A., Alshaib, B. M., & Kanaan, A. M. “The Interaction between Financial Development and Economic Growth: A Novel application of transfer entropy and Nonlinear approach in Algeria.” *SAGE Open 13* (No. 4 2023).

KOF Swiss Economic Institute. (2025), “KOF Globalization Index,” [Retrieved 2025-02-10] Available at: https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html.

Leitão, N. “Bank credit and economic growth: A dynamic panel data analysis.” *Economic Research Guardian 2* (No.2 2012): 256-267.

Liang, Q., & Teng, J. (2006). “Financial development and economic growth: Evidence from China.” *China Economic Review 17*(No.4 2006): 395–411.

Liu, W., & Hsu, C. “The role of financial development in economic growth: The experiences of Taiwan, Korea, and Japan.” *Journal of Asian Economics 17*(No. 4 2006): 667–690.

Neog, Y. & Yadava, A.K. “Nexus among CO2 emissions, remittances, and financial development: A NARDL approach for India.” *Environ. Sci. Pollut. Res 27* (2020): 44470–44481.

Njoya, E.T, & Nikitas, A. “The role of air transport in employment creation and inclusive growth in the Global South: The case of South Africa.” *J. Transp. Geogr 85* (2020), 102738.

Perron, P. “The great crash, the oil price shock, and the unit root hypothesis.” *Econom. J. Econom. Soc 57* (1989): 1361–1401.

Pesaran, M.H.; Shin, Y.; Smith, R.J. “Bounds testing approaches to the analysis of level relationships.” J. Appl. Econom. 16 (2001): 289–326.

Rahman, M. M., Shahbaz, M., & Farooq, A. “Financial Development, International Trade, and Economic Growth in Australia: New Evidence from Multivariate Framework Analysis.” Journal of Asia-Pacific Business, 16(No.1 2015), 21–43.

Raihan, A., Voumik, L. C., Akter, S., Ridzuan, A. R., Fahlevi, M., Aljuaid, M., & Saniuk, S. (2024). “Taking flight: Exploring the relationship between air transport and Malaysian economic growth.” Journal of Air Transport Management, 115, 102540.

Shin, Y.; Yu, B.; Greenwood-Nimmo, M. “Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework.” *In Festschrift in Honor of Peter Schmidt; Springer*, 2014; pp. 281–314.

Thrane, C. “Examining tourists' long-distance transportation mode choices using a multinomial logit regression model.” *Tourism Management Perspectives*, 15 (2015): 115-121.

Vasigh, B, and Pearce, B. “*Air Transport Economics: From Theory to Applications*.” 4th ed. Routledge. 2024.

Villanthenkodath, M.A.; Mahalik, M.K. “Does economic growth respond to electricity consumption asymmetrically in Bangladesh?” The implication for environmental sustainability. Energy 2021, 233, 121142.

World Development Indicators. [Retrieved 2025-02-10] Available at: https://databank.worldbank.org/source/world-development-indicators.

WTTC, 2025. Economic impact reports, world travel & tourism Council (WTTC). Available online: https://wttc.org/Research/Economic-Impact. Accessed 31 April 2025.

Yucel, F. “Causal relationships between financial development, trade openness and economic growth: the case of Turkey.” *Journal of Social Sciences 5* (No.1 2009), 33–42.