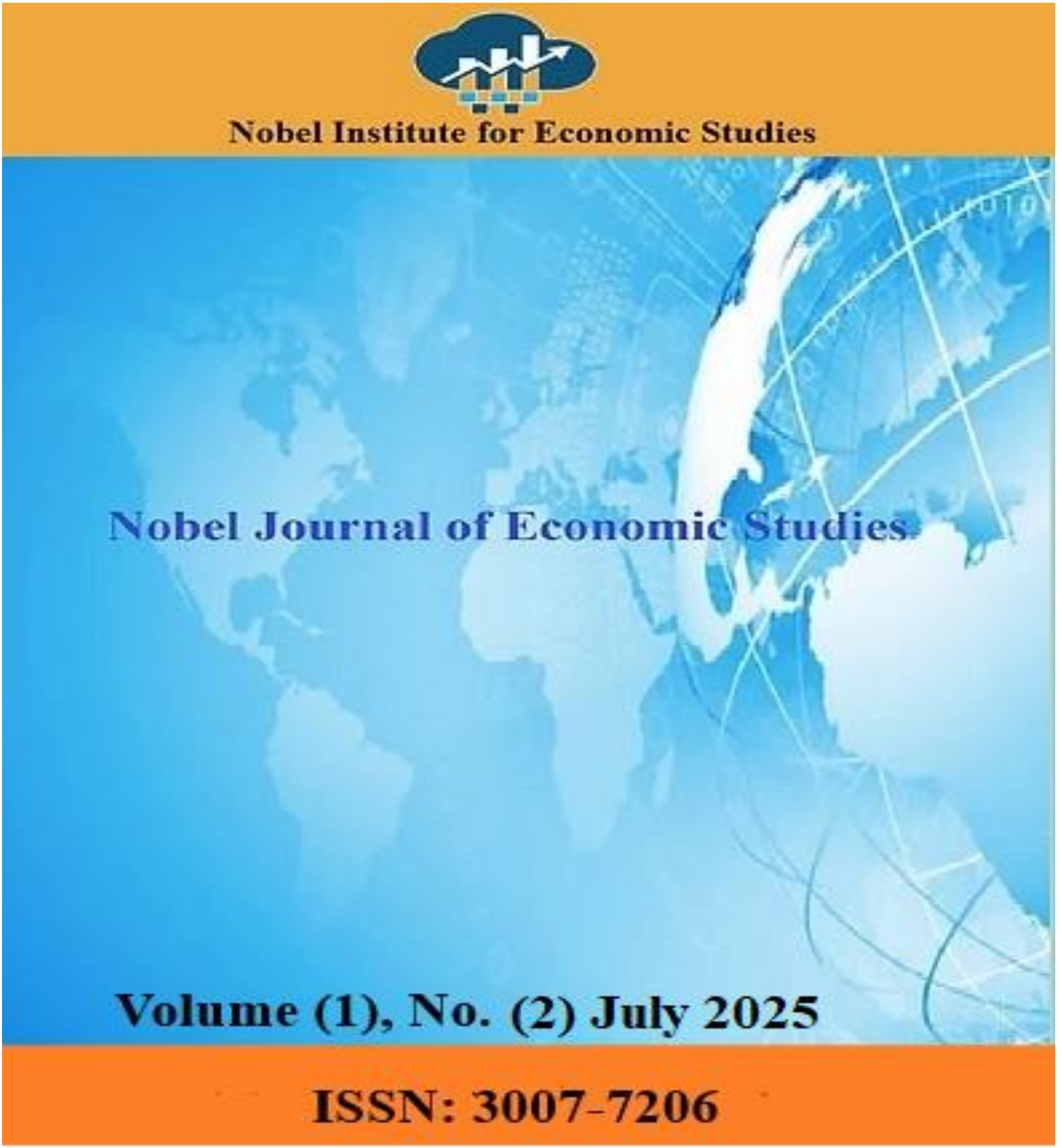
Nobel Institute for Economic Studies
Nobel Journal of Economic Studies
Volume (1), No. (2) July 2025
ISSN: 3007-7206

Publisher

Nobel Institute for Economic Studies
Banks Street, Al Rjoub Building, 1st Floor, Office, 2.
Dura-Hebron/ Palestine.
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Nobel Journal of Economic Studies

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An internationally refereed research journal

Published by: Nobel institute for economic studies

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International Standard Serial Number (ISSN)

(3007-7206)

Contents

Economic Growth Response to Exports in Turkey: A Cointegration Analysis

Nader Alzabadi[1]

Abstract

This paper scrutinizes the response of Turkey's economic growth to exports from 1980-2021, The data were obtained from the World Bank data system. This study employs cointegration and error correction model approaches. The empirical results show that the short-run dynamic behavior of Turkish economic growth has been tested by estimating an error correction model, the error correction coefficient is negative signed and statistically significant, and Granger causality shows no relationship between growth and exports.

Keywords: Exports, economic growth, labor, capital, ECM, Turkey.

JEL: F43. F49 . C32 . O55

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1. Introduction

The emergence of globalization enables countries to engage in a new phase of economic relations. Countries that followed the trade liberalization approach had a great opportunity to attract foreign investment, as these investments are one of the dynamic factors of production and international trade. Manufacturing expansion is portrayed as an "engine of growth". In emerging countries such as China and India, industrialization plays an essential role in sustainable growth. Free trade leads to more labor division and efficiency in resource allocation in these countries. Globally, the growth in manufacturing exports is driven by the accumulation of innovation, cheap intermediate and intra-trade, the reduced cost of transportation, and qualified industrial zones (QIZ). There is a controversial debate among scholars about the obscure relationship between exports and economic growth, some believe that exports are the key factor in sustaining growth based on export-led growth theory.

Counties with high export growth can witness accelerated specialization, as well as benefit from comparative advantage. Moreover, by exporting sectors taking advantage of the international division of labor, global competition demands exporting countries to keep costs low and employ more efficient operations. Export growth stimulates foreign direct investment leading to new technology and innovation which later shift aggregated demand and hold economic growth. The scale of economies and diversification as the motor of exporting base leads to new operation methods, human skills, and physical capital accumulation to support economies toward sustaining growth.

Export-led growth theory should be embodied by investment expansion; investment has a crucial role in reinforcing the growth of aggregate demand and enlarging the economy’s capacity by accumulating its capital stock and injecting a production base with advanced technology. Export growth indicators enhance the positive expectation of future economic growth, as well as, expanding exports allow countries to access the global capital market (Krueger, 1985).

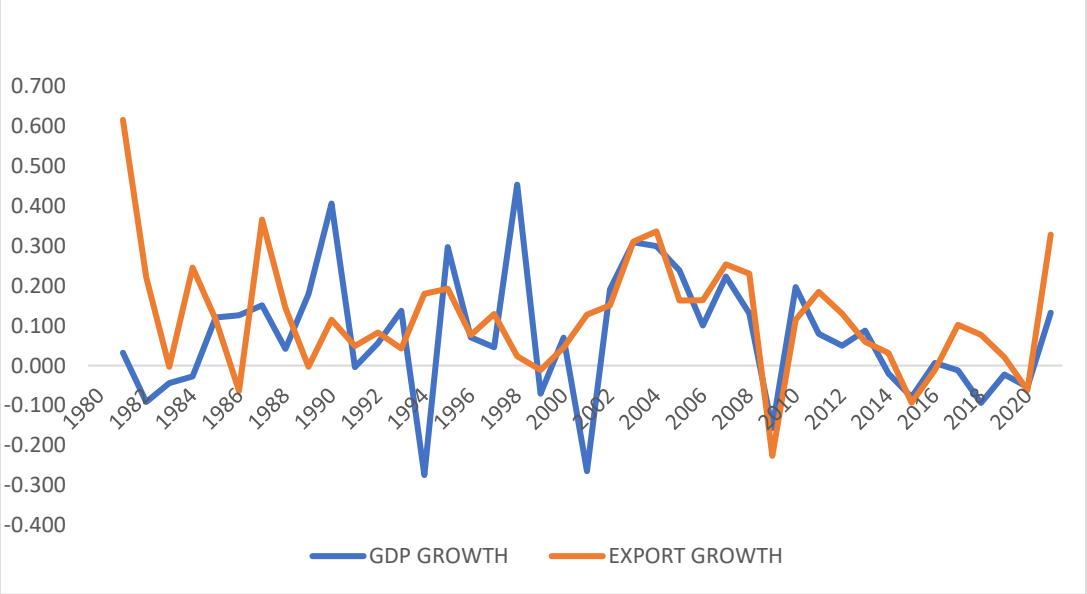
Based on the economic reform agenda of 1980, the Turkish government gave priority to supporting exporters and constructing companies to serve industries instead of traditional agricultural export sectors. This will lead to employing an import-substitution strategy, The relationship between economic growth and exports occupies high debate among scholars around the globe as well as Turkish economists, this puzzle is supported and rejected by each other.

The long -run relationship between Turkey’s exports and economic growth, were affected by both national and worldwide crises (Simdi & Seker ,2018). During past years Turkey achieved high growth in exports, economic growth affected positively (Aslan & Topu, 2018; Ozcan & Ozcelebi, 2013). The short-run and long-run relationship between exports and growth during 1965-2009 in Turkey tested, results

show that the relationship is not valid in the short run, nevertheless, the long-run relationship between exports and economic growth is supported (Temiz, 2010).
Turkey adopted economic reforms with a view to its access to international markets through the adoption of trade liberalization, reducing tariffs and attention to exports, which contributed to the growth of foreign trade significantly and doubled its size, where industrial products accounted for the highest percentage of total Turkish exports.

Figure 1. presents the trend of GDP rate and export rate from 1980 to 2021, it can be seen that the two variables present different trends in some years, in 1982 growth rate was recorded at -0.09 and exports recorded growth of nearly 0.22, in 1990 growth rate reached 0.40, in other hand, exports growth rate were 0.11, in 2009 turkey exported affected by global financial crises, in this year GDP rate and exports rate trend move at the same movement, overall, figure 1 shows that economic growth and exports rate move in a different direction.

Figure 1. GDP and Exports growth rate (1980-2021)



2. Literature review

In the opinion of numerous experts, the relationship between exports and economic growth is crucial. Exports increase economic growth by leveraging economies of scale and fostering greater competition for productivity (Bhagwati & Srinvasan, 1979). A nation must devote a sizeable portion of its resources to research and development in order to provide the market with cutting-edge products, even though it can achieve the economies of scale through the expansion of exports and reap these benefits over an extended period of time.

To diversify exports, countries increase resources which allocated to research and development (R&D), new innovations has a major role in economic growth (Barro, (1991; Mankiw, 1995) . It is vitally important to provide the global market with cutting edge goods and services using the most recent production process techniques, expertise, and information. It is crucial to provide the global economy with unique items because it is changing daily. The two additional elements that are crucial for the growth of exports are innovations and technology. According to Edward the creative and diverse product lines are responsible for the exports' that induce economic growth (Edward, 1992).

Indonesia in last years followed Export-led growth strategy, some study examined the nation's economic development using data on imports, exports, and exchange rates over 1980-2019. multiple regression analysis is employed as a research method in conjunction with the ordinary least square regression strategy. The results demonstrate that while imports are crucial in favorably impacting economic growth, exports and exchange rates only have an indirect effect on it. Surprisingly, the link between imports and exports exhibits notable positive results after being mediated by the currency rate. The government may also find the study's findings useful in formulating policies, particularly those pertaining to boosting economic growth through import and export operations (Haryani & Azam, 2021).
Recently, the effects of trade openness, imports, and exports on Namibia's economic growth examined. ARDL cointegration method employed. The findings indicate that imports and economic growth have a strong negative association, whereas exports and trade openness have positive and significant relationships with economic growth. Moreover, trade openness, imports, and exports are the main drivers of short-term economic growth. The results imply that trade liberalization and growth driven by exports are essential to Namibia's economic progress. All things considered, this research backs with the mercantilist thesis, which highlights how crucial it is to engage in international markets by growing trade and exports (Tafirenyika et al., 2023).

In a different study the connection between Namibia's GDP and exports from 1970 to 2005. The study supports an export-led growth strategy by demonstrating the large contribution of exports to economic growth through the application of Granger causality and cointegration methods (Jordaan & Eita, 2007)) . Exports and technology have a favourable and considerable impact on the economic growth of growing Asian economies, according to the Solow economic growth model (Md Reza, 2019) .The long-term estimate establishes the noteworthy and advantageous effects of commerce and technology on the nations' economies. Using various dynamic panel models, the results show a strong correlation between technology and exports and the countries' economic growth. In order to preserve steady economic growth, we advise policymakers to create enticing policies that can promote trade and technological advancement.

Exports are essential to the expansion and development of an economy. The important correlation between exports, technology, and economic growth in developing and emerging nations has also been highlighted by a number of recent studies (Dollar, 1992; Frankel & Romer, 1999; Radelet, Sachs, & Lee, 1997; Sachs, Warner, Aslund, & Fischer, 1995; Schiff & Wang, 2006; Baliamoune-Lutz (2011), World Bank, 1993). According to a study by Hagemejer and Mu_ck (2019), the GDP growth of the CEEC (Central and Eastern European) nations occurred between 1995 and 2014. It implies that, for the most part during the transition and EU integration, exports have been a significant factor in determining economic growth. It also demonstrates that the main force behind these nations' convergence with their more developed counterparts has been exports.

Some researchers investigate the relationship between Western Balkan Countries (WBCs) economic growth and technology-intensive exports between 2005 and 2015. The results indicate that the production of commodities, which is driven by medium-low and low-technology businesses, has the biggest impact on raising GDP per capita. These economies ought to grow their technology-driven sectors in order to mitigate their heavy reliance on high-end product imports. Thus, for any WBC nation, natural resources may play a key role in driving up overall exports and reindustrialization (Trlakovi et al., 2018).

Using panel data for 69 nations from 1975 to 1993, demonstrated the substantial and positive causal relationship between these countries' growth, exports, and export composition (Greenaway et al., 1999). Diversifying exports is a key component in helping developing nations boost economic growth. Similarly, industrialized nations are also benefiting from specialization in exports (Hesse, 2008).

In 1989, Canada and united state of America signed free trade agreement, bilateral trade increased, the causal relationship between trade and economic in Canada and united states of America examined, vector error correction employed on time series annual data 1948-1996, results support that the presence relation in Canada that trade induce growth and vice versa, while in us the relation is weak, moreover, results reveal that Canada is more open than USA and trade play significant role in Canadian growth (Zestos & Tao, 2002) .

India economy witnessed high economic growth, the relationship between exports and growth and other factors in India scrutinized, vector autoregression (VAR) employed on annual data during 1961-2015, results show a unidirectional relationship between RGFC economic growth and exports, imports had bidirectional relationship in long run, moreover, results show that exports sector has significant role in economic growth in India (Subhan et al., 2021).

The relationship between exports and GDP for BIMSTEC (Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka, and Thailand) nations tested, time series over period 1997-2015, results support the exports led growth and vice versa (Kaur et al., 2017).

Employed a nonparametric causality-in-quantile approach to test the relationship between export and Turkish economic growth, annual data used from 1960-2018, results show a positive causality from economic growth to export growth at low, while high -quantile ranges of export growth (Bahramian & salimiezhad, 2019).

In Singapore exports play important role in economic growth, Singapore has highly efficient infrastructure in logistic services, free trade policies applied as well as innovation in new products supported (Mahadevan, 2009).

Export-led growth hypothesis tested in Canada by constructing a vector autoregression (VAR) , granger causality test , two period were chosen , the first (1877-1945), the second (1946-1991), results show one way granger causal relationship , which indicates the growth rate of GDP in Canada influences export growth (Henriques & Sadorsky, 1996) . The relationship between exports, imports, and growth for Japan and south Korea has investigated, vector autoregression (VAR) employed, time period for Japan 1957-2003, and for south Korea 1963-2003, results show that a bidirectional causality between imports and growth in two countries, in Japan export-led growth hypothesis was supported, (Zang & Baimbridge ,2011; Awokuse, 2006; Koh & Mah (2013).

In south east Asian countries (Malaysia, Indonesia, Singapore, Thailand and Philippines), exports and economic growth have long run relationship, causality test reveal that domestic economic growth represents the vital one to cause exports to grow (Ahmad & Harnhirun,1996).

However, in South Korea exports and foreign direct investment not lead the economic growth (Berasaluce & Romero , 2017; Zang and Baimbridge, 2011). Moreover, Italian exports plays important role in growth, the relationship between exports, imports and economic growth in Italy scrutinized, study data from 1863-2004, cointegration analysis and causality tests employed, results confirms that a weak support for export -led growth and exports were not only the main factor of Italian economic growth (Pistores and Rinaldi, 2012).

3. Methodology of the study

The causality relationship between exports and Turkish economic growth is studied by employed a Cobb- Douglas production function which augmented to involve exports and imports (Balassa, 1978) (Fosu, 1990), (Riezman et al.,1996), imported inputs one of the main export's combinations especially technological devices.

This study assumes that the aggregated production of Turkish economy can be showed as a function of human capital, physical capital exports and imports:

$$Y_t = A_t K_t^{\alpha} HC_t^{\beta} \quad (1)$$

Where Y_t denotes the aggregate production of Turkish economy at time t, A_t is total factor productivity, while K_t represent physical capital, in this study Gross fixed capital formation taken as a proxy for physical capital, and HC_t represent human capital (labor force).

While, total factor productivity can be expressed as a function of exports, imports, and other exogenous factors , C_t :

$$A_t = (X_t, IMP_t, C_t) = X_t^{\gamma} IMP_t^{\delta} C_t \quad (2)$$

After combining (1), (2) the following equation is obtained:

$$Y_t = C_t K_t^{\alpha} HC_t^{\beta} X_t^{\gamma} IMP_t^{\delta} \quad (3)$$

Where $\alpha, \beta, \gamma \; and \; \delta$ indicate production elasticities with respect to production inputs. Natural log has taken of both sides of equation (3) obtained the following:

$$LY_t = C + \alpha LK_t + \beta HC_t + \gamma LX_t + \delta IMP_t + \varepsilon_t \quad (4)$$

In more specification, in this research GDP used instead of Y, Eq (4) become as:

$$LGDP_t = C + \alpha LK_t + \beta HC_t + \gamma LX_t + \delta IMP_t + \varepsilon_t \quad (5)$$

$$\Delta \ln GDP_t = \alpha + \sum_{i=1}^{n} \beta_{1i} \Delta GDP_t + \sum_{i=0}^{n} \beta_{2i} \Delta \ln K_t + \sum_{i=0}^{n} \beta_{3i} \Delta \ln \beta HC_t + \sum_{i=0}^{n} \beta_{4i} \Delta \ln \gamma LX_t + \sum_{i=0}^{n} \beta_{5i} \Delta IMP_t + \mu \mathrm{ECM}(-1) + \varepsilon_t \quad (6)$$

Where $\mu < 0$.

The theory of cointegration reports this issue by using an error correction term to capture the short-dynamic effects, this led us to transformation of a general error correction model (ECM):

Annual time series obtained from world bank over the period 1980-2021, macroeconomic variables are expressed in current price. Descriptive statistics are show in Table 1. Prior investigating the presence of a causal relationship between exports and growth in Turkey during 1980-2021, it is necessary to show that variables are stationary. Augmented Dickey-Fuller (ADF) test, Phillip- Perron (PP) test achieved.

4. Empirical results and discussion

4.1 Descriptive statistics

This study tried to explore the relationship between economic growth and some macroeconomic variables (exports, imports, human capital, physical capital) from 1980 to 2021, with annual data employed. Study variables, GDP as a proxy of economic growth, labor force as a proxy of human capital, and physical capital). Table 1 and below encompass descriptions of the GDP, exports (X), imports (IM), labor force (LA), Gross fixed capital formation (GFCF) variables in the model, and some descriptive statistics:

Table 1. Descriptive statistics of the series for the period 1980-2021

Statistics	**GDP**	**LA**	**GFCF**	**X**	**IM**
Mean	411.0084	23.26819	108.1934	69.69852	109.8031
Median	265.3442	22.24100	55.94830	29.55450	56.32550
Maximum	957.7830	33.42000	271.4978	225.2910	292.0070
Minimum	59.98991	16.23000	8.635900	2.910000	8.209000
Std. Dev.	323.8607	4.907131	94.61656	67.38980	99.22389
Skewness	0.411446	0.690219	0.506108	0.672775	0.527934
Kurtosis	1.480556	2.443021	1.592407	1.945375	1.618176
Jarque-Bera	5.225257	3.877712	5.260327	5.114792	5.292519
Probability	0.073342	0.143868	0.072067	0.077506	0.070916
Sum	17262.35	977.2640	4544.121	2927.338	4611.732
Sum Sq. Dev.	4300316.	987.2775	367044.1	186196.8	403660.6
Observations	42	42	42	42	42

Source: author calculation

4.2 Unit root test for stationarity

Table 3 reports the result of unit root for the following variables (GDP, exports, imports, labor capital, physical capital) in our study. Results of Dickey- Fuller (ADF) unit root test suggest that all variable are non-stationary at level but become stationary at first difference, to summarize all the variables are integrated at order I(1).This result enable us to apply ARDL method.

The first steps of the estimation autoregressive distributed lag (ARDL), Augmented Dickey-Fuller (ADF) and Phillips-person (PP) unit root tests employed to check the stationarity. The results of these tests are portrayed in Table below.

Table 2. Results of unit root test

Variables	**ADF Test Statistics (with Trend and Intercept)**			**PP Test Statistics (with Trend and Intercept)**		
	Level	First Difference		Level	First Difference	
GDP	-1.7006	-5.5253*	I(1)	-1.9591	-5.6096*	I(1)
EX	-1.3394	-5.2590*	I(1)	-0.9110	-5.2590*	I(1)
IM	-2.1810	-5.9137*	I(1)	-2.2008	-5.8580*	I(1)
LA	-1.1698	-6.2892*	I(1)	-1.2888	-6.2999*	I(1)
GFCF	-1.9338	-5.4404*	I(1)	-2.0619	-5.4436*	I(1)

Source: author calculation

The results indicated that the null hypothesis of the series contains a unit root that cannot be rejected at a level for all variables in the ADF and PP unit root approach. However, this null hypothesis can be rejected when those variables are transformed into first difference forms.

Meanwhile, the number of lag periods has an impact on the result of cointegration. Then, we have selected these through AIC & SC. Since annual data has been used in the study, a maximum of one lag period has been selected Based on minimum AIC and SC values as seen in Table 3.

Table 3. Lag selection

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	70.39499	NA	2.20e-08	-3.441842	-3.226370	-3.365178
1	237.2492	281.0176	1.28e-11	-10.90785	-9.615021*	-10.44787*
2	266.2479	41.20873*	1.11e-11*	-11.11831	-8.748122	-10.27502
3	286.3065	23.22568	1.75e-11	-10.85824	-7.410686	-9.631624
4	317.9711	28.33153	1.87e-11	-11.20901*	-6.684098	-9.599079

* Indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error

AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

4.3 Johansen-Juselius maximum likelihood Cointegration test

Johansen's cointegration procedures were employed to determine the number of cointegration vectors. The lag was set at one depend on selection made by several criterion. On the basis of the unit root results, Johansen-Juselius applied to determining whether any combinations of the study variables model are cointegrated**.** Table 4 shows the Johansen-Juselius cointegration results.

Table 4. Johansen-Juselius maximum likelihood cointegration test

Trace test				Maximal Eigen value Test			
Null	Alternative	Statistic	0.05 Critical Value	Null	Alternative	Statistic	0.05 Critical Value
r =0	r =1	84.82375*	69.81889	r =0	r =1	35.46701*	33.87687
r ≤1	r =2	49.35674*	47.85613	r ≤1	r =2	22.50905	27.58434
r≤2	r =3	26.84769	29.79707	r≤2	r =3	15.41829	21.13162
r ≤3	r =4	11.42939	15.49471	r ≤3	r =4	11.28241	14.26460
r ≤4	r =5	0.146981	3.841466	r ≤4	r =5	0.146981	3.841466

Source: author calculation

Notes: (i) r stands for the number of cointegrating vectors.

(ii) * denotes rejection of null hypothesis of no cointegration at 5% significance level.

The results from trace statistics indicate that the null hypothesis of zero is rejected at 95% critical value which means two cointegration vectors exist (r =2). this verifies the conclusion that there are only two cointegrating relationships among the five I(1) variables. However, the Maximal Eigenvalue Test revealed that the statistic value is 84.82 above the 95% critical value of 69.81. Hence it rejects the null hypothesis r=0, in favour of the general alternative r=1. Results conclude that there is only one cointegration among the five study variables (GDP, Exports, imports, Labor capital, Gross fixed capital formation).

4.4 Estimation Error -Correction Model

The error correction model obtained from the ECM test provides knowledge about the short-run effects of variables on exports, Table 4 contains the estimation results from the error correction model, results explain the short-run effects of exports, imports, labor, and Gross fixed capital formation, on growth.

Table 5. Short-run coefficients estimation and error correction representation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(LA)	-0.177657	0.153185	-1.159754	0.2542
LOG(X)	-0.019060	0.088396	-0.215620	0.8306
LOG(IM)	0.202634	0.108186	1.873016	0.0697
DLOG(GFCF)	0.487785	0.056579	8.621381	0.0000
CointEq(-1)*	-0.377575	0.091332	-4.134092	0.0002
R-squared	0.851113	Mean dependent var		0.060292
Adjusted R-squared	0.847295	S.D. dependent var		0.149388
S.E. of regression	0.058377	Akaike info criterion		-2.796244
Sum squared resid	0.132906	Schwarz criterion		-2.712656
Log likelihood	59.32301	Hannan-Quinn criter.		-2.765806
Durbin-Watson stat	1.971461			

Source: author calculation

According Table 5, ETC (1) value appear with a negative sign-0.37, this value is significant at level 1% implying that the whole system may get back to the long-run equilibrium at the speed of adjustment 37.75% one period after the exogenous shock.

4.5 Granger causality test

The result of the Granger causality test, Table 6 shows that Turkey has no relationship between exports and growth, imports and growth, On the other hand, results show a directional relationship from growth to labor, while there is a bidirectional relationship between Gross fixed capital formation and Growth.

Table 6. Granger causality test

Null Hypothesis	F- statistics	Probability
X does not Granger Cause GDP	1.04275	0.3632
GDP does not Granger Cause X	1.79249	0.1815
IM does not Granger Cause GDP	0.28774	0.7517
GDP does not Granger Cause IM	0.92768	0.4050
LA does not Granger Cause GDP	0.55908	0.5768
GDP does not Granger Cause LA	8.31250	0.0011
CA does not Granger Cause GDP	4.17705	0.0236
GDP does not Granger Cause CA	7.09953	0.0026
X does not Granger Cause LA	4.97744	0.0125
LA does not Granger Cause X	3.43212	0.0435
X does not Granger Cause CA	3.86176	0.0305
CA does not Granger Cause X	8.16733	0.0012
IM does not Granger Cause X	7.52605	0.0019
X does not Granger Cause IM	3.53620	0.0399

Source: author calculation

5. Conclusion

In our empirical examination of the relationship between economic growth and exports in Turkey, cointegration and error correction modelling methodology have been employed, results show an equilibrium relationship among variables, GDP, exports, imports, human capital, and Gross fixed capital formation. To determine the short-run dynamic around the equilibrium relationship, an error correction model (ECM) is estimated, the value of ECM is found to be statistically significant, confirming the long-run relationship is valid, moreover, the error correction term is -0.37 which indicates that a high speed of adjustment to equilibrium.

Granger causality test show that exports and imports do not cause economic growth in Turkey, however, there is a bidirectional relationship between Gross fixed capital

formation and economic growth, and finally, there is a directional relationship from economic growth to human capital.

The policy implications that, the export-led growth strategy can't be applied to the Turkish case, expanding Gross fixed capital formation as advanced countries did, represent the fit mechanism toward paving the way for sustaining economic growth.

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Interaction Among Economic Growth and Some Macroeconomic Variables in Jordan

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Abstract

This research explores the interaction between economic growth and some Macroeconomic Variables in Jordan (public expenditures, trade openness, foreign direct investments, gross capital formation, Labor force, inflation rates), annual time series from 1980 to 2022 employed, utilizing the auto-regressive distributed lag (ARDL) bounds testing method for cointegration to provide policy recommendations regarding the effectiveness of macroeconomic factors both in the short and long term. The empirical findings show that gross domestic product (GDP) cointegrated with macroeconomic variables. The outcomes of the long-run analysis indicate that public expenditures, gross capital formation, and the labor force positively influence Jordan's economic growth. In the short run, public expenditures, gross capital formation, and low inflation rates, have a favorable impact on economic growth in Jordan. However, trade openness has negative impact on Jordan's economic growth in short run. The study suggests that Jordanian policymakers should focus on enhancing gross capital formation levels, maintaining low inflation rate, reviewing trade liberalization policies.

Jel: H54, Oi, H4, P33. L9, C32

Keywords: Economic growth, inflation, public expenditures, FDI, ARDL.

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1. INTRODUCTION

Globalization has led to a notable rise in economic integration, trade openness and foreign investments characterizing the current stage. Economic growth is closely linked to a country's ability to efficiently allocate its economic resources in line with a strategic plan aimed at achieving sustainable growth. Economic openness is viewed as a crucial element in attracting foreign investments. A nation that boasts a high degree of economic freedom and fosters an investment-friendly environment is more likely to develop effective planning policies geared toward sustainable growth (Hye and Lau, 2015). The influx of foreign investments, particularly those focused on productivity, aids other sectors of the economy in supplying essential inputs, which in turn propels economic growth. Amid global competition, human resources have become increasingly significant to the production process. The labor force currently serves as the foundation of economic productivity. Recently, several nations have adopted a new Keynesian perspective, emphasizing that governments must significantly contribute to economic growth by increasing public expenditures. The linkage between public expenditures and economic growth has been formed by theoretical concepts introduced by Wagner and Keynes. Wagner contended that economic growth drives public expenditure, while Keynes defended the notion that public spending fuels economic growth. In his analysis of various 19th-century countries, Wagner (1883) observed a consistent rise in public expenditures, which he attributed to the evolving responsibilities of the state within economic and social realms. Wagner proposed that societal advancement exerted pressure, prompting modifications in the economic roles of both the public and private sectors (Musgrave and Peacock, 1958). Conversely, Keynes posited that public spending acts as an external instrument that can be employed as a policy measure aimed at influencing economic growth and addressing short-term fluctuations.

Unlike Wagner, Keynes (1936) maintained that public expenditures do not emerge from economic growth, but rather that economic growth arises from elevated public expenditure. The pursuit of sustained and equitable economic growth remains a primary objective of public expenditure policy. Numerous public initiatives are specifically designed to foster sustained and equitable economic growth. Over time, public expenditures can play a vital role in the formation of both physical and human capital. Well-structured public spending can also effectively enhance economic growth, even in the short term, when constraints on infrastructure or skilled labor become significant barriers to production increases. Low inflation and exchange rate stability will sustain economic growth, Fischer (1993) ensure that high inflation has negative impact on economic growth by decreasing investment and reducing productivity.

Economic growth in Jordan is viewed as a critical issue that economic decision-makers aim to resolve. Investigating the connection between economic growth and various macroeconomic factors in Jordan is a crucial topic that has captured the researcher's interest in this study. Nowadays, economic growth has experienced a notable decline, presenting a substantial obstacle to economic development. This research examines several key factors, exploring how their interactions with other variables might positively influence growth. The primary aim of this study is to analyze the long and short run relationships between economic growth and various macroeconomic variables in Jordan from 1980 to 2022 by utilizing autoregressive distributed lag (ARDL) model developed by Pesaran et al. (2001).

2. LITERATURE REVIEW

Today global economy marked by significant interconnections among macroeconomic variables, particularly due to economic globalization and increased openness between nations. National economies are rapidly affected by international changes, such as investment, inflation, and labor force. Countries that can effectively manage the interplay of these variables with economic growth are those that have succeeded in sustaining economic development while also mitigating the adverse impacts of globalization. Numerous studies have examined the strong interrelations between macroeconomic indicators and growth. Aydın et al. (2016) employed dynamic panel data to explore the link between inflation and economic growth across five countries (Azerbaijan, Kazakhstan, Kyrgyzstan, Uzbekistan, and Turkmenistan). The results revealed a nonlinear relationship between the growth rate and inflation. Švigir et al. (2017) analyzed the correlation between inflation and economic growth in Austria and Italy from 1980 to 2016, two nations with historically low inflation rates. Results indicated that while low inflation is essential, it alone does not guarantee economic growth.

Raghutla (2020) investigated the effect of trade openness policy on economic growth in five developing economies using panel data from 1993 to 2016. The empirical findings, confirm the existence of long-term relationships among trade openness, financial development, inflation, labor force participation, technology and economic growth. The results of the panel non-causality tests further reveal a unidirectional causal relationship between short-term financial development and trade openness, as well as a bidirectional connection between inflation and economic growth. Ultimately, the findings indicate that in these five developing economies, trade openness policies play a crucial role in boosting economic growth.

Nguyen and Hung (2020) analyzed how Vietnam's labor force and various macroeconomic elements influence the nation’s economic growth. Leveraging a secondary time series data set spanning 1998 to 2018, the researchers employed an empirical model to conduct regression and correlation analyses the effects of the labor

force, foreign direct investment, exports, and inflation on Vietnam's economic growth. The results indicate that both the labor force and foreign direct investment positively impact economic growth, exports of goods and services also have a positive effect, while the annual inflation rate negatively influences economic growth.

Meyer and Sanusi (2019) examined the relationships between employment, gross fixed capital formation and economic growth in South Africa. Using data from 1995Q1 to 2016Q4, the study utilized Johansen cointegration and Vector Error Correction Models (VECM). Findings reveal a long-term connection among employment, domestic investment, and economic growth. Additionally, the results indicate that investments positively affect employment in the long run. The data also suggests a unidirectional causal relationship from investment to employment, alongside a bidirectional relationship between employment and economic growth.

Pasara and Garidzirai (2020) examine the causal relationships among Gross Capital Formation, Unemployment, and Economic Growth in South Africa by utilizing time series data spanning from 1980 to 2018 within a Vector Autoregressive (VAR) framework. Their findings show a favorable long-term correlation between gross capital formation and economic growth, additionally suggesting that unemployment has no effect on economic growth (GDP) in the short term.

Miku et al. (2023) examined the relationship between economic growth and trade openness in Tanzania, annual time series data from 1970 to 2021 used, Vector Autoregressive employed, the findings revealed that trade openness has a substantial and positive effect on Tanzania's economic growth, Additionally, there is a statistically significant negative correlation between GDP growth rates and gross national savings.

Burange et al. (2019) utilized analysis as an econometric method to investigate the causal relationship between trade openness and economic growth for BRICS member countries. Annual time series used since the late 1980s, results revealed that a growth-led trade in India services sector, growth-led export and import hypotheses for China and South Africa; however, no clear causal relationship was established for Brazil and Russia.

Chen et al. (2020) scrutinized the relationship between government expenditures and Vanuatu's economic growth between 1981 and 2016. Results confirms that fiscal variables and investment growth have causal influences on economic growth in Vanuatu in short run. Emrah et al. (2019) checked the Granger-causal relationships between trade openness and economic growth in Turkey from 1950 to 2014. Findings show that there is a strong relationship between trade openness and economic growth

Fatima et al. (2020) investigated the effects of trade openness on GDP growth. Generalized method of moments (GMM) estimator used, specifically designed for dynamic panel data models. Study data encompasses both developed and developing

countries from 1980 to 2014. The results revealed an interesting indirect relationship between GDP growth and trade openness. Wuladari et al. (2020) examined the relationship between economic growth and macroeconomic factors such as export, investment, and E-money transactions in Indonesia. The quarterly time series from 2010 to 2017 used. The Vector Error Correction Model (VECM) to identify short- and long-run relationships. Results revealed that Economic growth in Indonesia influenced positively by investment in long and short run, however, influenced negatively by export and E-money transactions.

Haque et al. (2019) conducted a study that explores the connection between the labor force participation rates of both genders, gross fixed capital formation, and economic growth in Bangladesh, utilizing annual time series data from 1991 to 2017. The findings reveal two bidirectional links: one between overall labor force participation and economic growth, and the other between gross fixed capital formation and economic growth. Additionally, the results indicate a unidirectional causal relationship between female labor force participation to economic advancement in Bangladesh. The study also demonstrates that both total and female labor force participation has significant positive effects on economic development in the short run, but negative effects in the long run. Conversely, gross fixed capital formation shows significant short-term negative implications for economic growth, while it has a clear positive impact on Bangladesh's economic development in the long term.

Dinh et al. (2019) examined how foreign direct investment (FDI) impact on economic growth in developing countries within the lower-middle-income group from 2000 to 2014. To ensure the reliability of the findings, a range of econometric methods were employed, such as the Johansen cointegration test, Fully Modified OLS (FMOLS), Vector Error Correction Model (VECM), and panel-based unit root test. The results of the study suggest that although FDI has a negative short-term effect on the country's economic growth analyzed. In the short run, an increase in money supply promotes growth, while a rise in the overall credit extended to the private sector has the opposite effect. Moreover, factors such as money supply, human capital, total domestic investment, and domestic credit for the private sector are identified as the primary drivers of long-term economic growth.

Rahman et al. (2023) explored the relationship between government expenditure and economic growth in the SAARC nations (Bangladesh, India, Pakistan, Sri Lanka, and Bhutan). panel data from 2011 to 2020 employed. random effects panel OLS model technique used; results indicated that government spending in SAARC countries has a significant positive effect on GDP

Fazaalloh (2024) analyzed sectoral data at the provincial level across Indonesia's 33 provinces to study the role of foreign direct investment (FDI) in economic growth from

2010 to 2019. Results indicate that FDI generally exerts a significant positive influence on economic growth in Indonesian provinces. Furthermore, the findings indicate that foreign direct investment (FDI) substantially enhances economic growth in manufacturing sector, mining, water, gas, electricity, hotels, restaurants, and real estate sectors.

Nguyen et al. (2023) examined the connection between trade openness and the three main components of macroeconomic from 2011 to 2019 in 20 Asian countries stability—growth, inflation, and exchange rate. The autoregressive distributed lag (ADRL). The results indicated that, in the short term, exchange rate stability was positively associated with trade openness, while growth stability in Asian countries was negatively associated with it. However, no correlation was found between trade openness and inflation stability, which suggests a need for further investigation. Through an analysis of labor, capital stock, and trade openness as determining variables.

Keho (2017) explored the relationship between trade openness and economic growth in Cote d'Ivoire from 1965 to 2014. It utilized Granger causality along with the Autoregressive Distributed Lag Bounds test for cointegration. The results indicate that trade openness fosters economic growth both in the short and long term. Additionally, the findings highlight a strong and positive relationship between trade liberalization and the capital accumulation in promoting economic growth. Poku et al. (2022) analyzed data from 1970 to 2016, utilizing the ARDL econometric estimation technique to explore the relationship between government expenditure and economic growth in Ghana. The empirical findings reveal a short-term positive association between government spending and economic growth. Moreover, the results exhibit a robust positive correlation between GDP and foreign direct investment in both the short and long term. Conversely, an inverse relationship was observed between population growth and GDP growth.

3. Model specification and Methodology

Production function represented the framework for classical and neoclassical growth theories, interaction between economic growth and macroeconomic variables presented in extended production function as follow:

Traditional production function $Q = AF(L, K)$ (1)

By extending production function by introducing some macroeconomic variables, foreign direct investment (FDI), trade Openness (OP), inflation rate (INF), gross capital formation(K), and public expenditures (PEX), it become:

$$Q = C\ L^{\beta},\ K^{\alpha}, OP^{\delta}, FDI^{\gamma}, INF^{\emptyset}, PEX^{\theta} \quad (2)$$

By applying the natural logarithm to both sides of equation (2), estimation function become as follows:

$$lnGDP = C + \beta lnL + \alpha lnK + \delta lnOP + \gamma lnFDI + \emptyset lnINF + \theta LnPEX + e \quad (3)$$

$$f_K \geq 0, f_L \geq 0 f_{op} \geq 0, f_{INF} \geq 0, f_{FDI} \geq 0, f_{PEX} \geq 0$$

Where *ln* denotes natural logarithm, C represents a constant parameter, e is the error term, $\boldsymbol{\beta}, \boldsymbol{\alpha}, \boldsymbol{\delta}, \boldsymbol{\gamma}, \emptyset, \boldsymbol{\theta},$ denote constant elasticity coefficients of output.

3.1 ARDL Procedures

This research utilizes the ARDL bounds testing method for cointegration introduced by Pesaran, Shin, and Smith (2001) to analyze the empirical connections between the study variables. The ARDL model provides reliable outcomes, especially when dealing with small sample sizes.

$$lnGDP = C + \beta lnL + \alpha lnK + \delta lnOP + \gamma lnFDI + \emptyset lnINF + \theta LnPEX + e$$

$$\Delta GDP_t = C + \eta GDP_{t-1} + \beta L_{t-1} + \alpha k_{t-1} + \delta Op_{t-1} + \gamma FDI_{t-1} + \emptyset Inf_{t-1} + \theta Pex_{t-1} + \sum_{i=1}^{p} \eta_2 GDP_{t-i} + \sum_{i=0}^{p} \beta_2 L_{t-i} + \sum_{i=0}^{p} \alpha_2 K_{t-i} + \sum_{i=0}^{p} \delta_2 OP_{t-i} + \sum_{i=0}^{p} \gamma_2 FDI_{t-i} + \sum_{i=0}^{p} \emptyset_2 INF_{t-i} + \sum_{i=0}^{p} \theta_2 PEX_{t-i} + \varepsilon_t \quad (4)$$

In this context, Δ denotes the first difference operator; C represents an intercept, ε_t error term, he long-run coefficients are labeled as $\eta, \beta, \alpha, \delta, \gamma, \emptyset, \theta,$ whereas $\eta_2, \beta_2, \alpha_2, \delta_2, \gamma_2, \emptyset_2, \theta_2$ indicate the short-run coefficients that form the underlying ARDL model.

Subsequently, the short-run dynamics can be derived through the error-correction model (ECM) presented in Equation (5), which is outlined as follows:

$$\Delta GDP_t = C + \sum_{i=1}^{p} \eta GDP_{t-i} + \sum_{i=0}^{p} \beta L_{t-i} + \sum_{i=0}^{p} \alpha K_{t-i} + \sum_{i=0}^{p} \delta OP_{t-i} + \sum_{i=0}^{p} \gamma FDI_{t-i} + \sum_{i=0}^{p} \emptyset INF_{t-i} + \sum_{i=0}^{p} \theta PEX_{t-i} + \mu ECM_{t-i} + \varepsilon_t \quad (5)$$

3.2 Data definition and sources

This article utilizes secondary data primarily gathered from the World Bank. The econometric analysis focuses on an annual time series spanning from 1980 to 2022. Various proxy indicators have been identified to assess the dynamic relationship

between the selected variables and their impact on economic growth in Jordan. Gross domestic product (GDP) at current prices serves as a proxy for economic growth.

Table 1. Descriptive Statistics (1980-2022)

	LOG(GDP)	LOG(FDI)	LOG(L)	LOG(OP)	LOG(INF)	LOG(PEX)	LOG(K)
Mean	23.22347	-1.466093	7.065491	4.318535	0.920980	8.339034	1.443994
Median	22.91780	-1.019069	7.090721	4.333969	1.250957	8.004733	1.316408
Maximum	24.60799	1.265258	8.009396	4.720162	3.246986	9.598435	2.246015
Minimum	22.08681	-6.607795	6.040255	3.871549	-6.907755	7.349745	0.565314
Std. Dev.	0.874359	2.098723	0.604045	0.185545	1.590257	0.764281	0.507600
Skewness	0.345045	-0.545550	-0.143221	-0.088585	-2.874027	0.343919	0.121944
Kurtosis	1.545925	2.216786	1.941132	3.161985	14.83518	1.493604	1.637307
Jarque-Bera	4.641416	3.232033	2.155825	0.103252	310.1584	4.913375	3.433576
Probability	0.098204	0.198689	0.340305	0.949684	0.000000	0.085718	0.179642
Sum	998.6094	-63.04201	303.8161	185.6970	39.60214	358.5785	62.09173
Sum Sq. Dev.	32.10914	184.9948	15.32457	1.445930	106.2145	24.53329	10.82162
Observations	43	43	43	43	43	43	43

Source: Author's own computation.

4. EMPIRICAL RESULTS

4.1 Stationary tests

The Autoregressive Distributed Lag (ARDL) approach can be used even if there is uncertainty about whether the underlying regressors are stationary at I(1) or I(0); however, the bounds test is not applicable for I(2) processes (Ouattara, 2004). Therefore, unit root tests were conducted using the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test to ensure that none of the study variables are integrated at I(2). The results of the unit root tests are presented in Table 2.

Table 2. Results of stationarity

ADF Unit Root Test			Phillips-Perron (PP) Test		Conclusion
Variable	**Level**	**Ist Difference**	**Level**	**Ist Difference**	
GDP	-1.630	-4.369***	2.022	3.0778**	Stationary :I(1)
K	-1.284	-5.561***	-1.288	-5.535***	Stationary :I(1)
FDI	-1.671	-6.233***	-1.759	-6.230***	Stationary :I(1)
L	-1.104	-3.446**	2.107	-3.416***	Stationary :I(1)
INF	-3.917***	-7.309***	-3.717***	-18.094***	Stationary :I(0) I(1)
PEX	2.693	6.587***	-2.364	-5.390***	Stationary :I(1)
OP	-2.886	-3.541**	-2.338	-4.880***	Stationary :I(1)

Source: Author's own computation.

Based on the data presented in Table 2, the null hypothesis of nonstationarity for the variables GDP, K, FDI, L, PEX, and OP cannot be rejected at their level values; however, it can be rejected at the first differenced level at a significance level of 1%. This suggests that these variables follow an integrated I(1) process, indicating that the variables are integrated of both I(0) and I(1) processes. Given these findings, the ARDL approach can be appropriately utilized to examine the cointegration relationships among the variables in the time series.

4.2 Lag Selection

Wooldridge (2015) proposed that with annual data there should be optimal lags which should be selected correctly. Schwarz information criterion (SIC) eliminates the uncertainly problem in model selection (Yang, 2005), based on Table 3, optimal lag is 4.

Table 3. Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-81.29815	NA	2.18e-07	4.528110	4.826698	4.635241
1	141.6533	354.4357	3.04e-11	-4.392478	-2.003775	-3.535432
2	217.4421	93.27851	9.89e-12	-5.766263	-1.287443	-4.159301
3	303.2149	74.77626	3.19e-12	-7.652045	-1.083110	-5.295168
4	439.5570	69.91902*	2.57e-13*	-12.13113*	-3.472076*	-9.024334*

*indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

4.3 Bounds test

The bounds test provides a comprehensive insight into the long-term relationship between variables. The F-statistics from the cointegration analysis using the ARDL model exceed the upper values of the bounds, indicating that the condition for cointegration among the model variables has been met. Table 4 illustrates these results as follows.

Table 4. Results of Cointegration

Dependent variable	**Cointegration Hypothesis**	**F-statistic**	**Decision**
GDP	F(GDP/FDI, OP,K,L, PEX,INF)	5.618***	Cointegration
FDI	F(FDI/ GDP, OP, K, L, PEX, INF)	4.733***	Cointegration
PEX	F(PEX/GDP, OP, K, L, INF, FDI)	6.650***	Cointegration
K	F(K/GDP, OP, FDI, INF, PEX, L)	5.828***	Cointegration
Bounds	**Significance**		
	10%	5%	1%
Lower I(0)	1.99	2.27	2.88
Upper I(I)	2.94	3.28	3.99

Source: Author's own computation

The F-statistics higher than the upper bound at the 5% significance level, indicating that the necessary conditions for cointegration among the model variables have been met. As a result, we reject the null hypothesis of no cointegration in favor of the alternative hypothesis, which suggests long-term interrelationships among the variables when GDP is treated as the dependent variable. Consequently, this model is suitable for analyzing both short-term and long-term relationships among the variables.

4.4 Long and short Run Estimation

Achieving economic growth in long and short run affected by many macroeconomic variables, particularly in uncertainty environment, Table 5. Show that an increase in public expenditures by 1% will increase economic growth by 0.79%, this indicate that public expenditure plays significant effect in Jordan's growth in long run. Gross capital formation has a significant impact on Jordan's growth, an increase of 1% in gross

capital formation will lead to growth of 0.23%. Additionally, Labor in many economies plays an imperative impact in growth, according to our estimation, the labor force has a positive impact on growth, an increase of 1% in the labor force will lead to growth of 0.20%. However, trade openness inflation, and FDI do not have a real impact on Jordan's economic growth in the long run.

Table 5. long -run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(PEX)	0.798327	0.083910	9.514108	0.0000
Ln(INF)	0.044464	0.038891	1.143317	0.2860
Ln(K)	0.231806	0.067120	3.453603	0.0086
Ln(FDI)	0.031901	0.019102	1.670013	0.1335
Ln(L)	0.202806	0.044794	4.527520	0.0019
Ln(OP)	-0.321461	0.244757	-1.313387	0.2255
C	16.30704	1.377979	11.83403	0.0000

Source: Author owns computation.

In order to know the effect of the interaction between economic factors on Jordanian economic growth in the short term, a short-term test was conducted as shown in the Table 6. Results Coefficients revealed that public expenditures, low inflation rate, Gross capital formation, Labor force, have significant impact on Jordan's economic growth. Nevertheless, trade openness has negative impact on Jordan’s economic growth in short run, foreign direct investment not has significant impact on economic growth. While the ECM term is significant and displays a negative value. The rate of adjustment for deviations from equilibrium in the previous year's growth for Jordan is measured at a speed of 91%.

Table 6. Short-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (PEX)	0.693753	0.047616	14.56982	0.0000
D (INF)	0.009057	0.003834	2.362028	0.0458
D (K)	0.177778	0.022075	8.053328	0.0000
D(FDI)	-0.000875	0.003395	-0.257734	0.8031
D(L)	0.272652	0.130053	2.096466	0.0693
D(OP)	-0.467360	0.064306	-7.267762	0.0001
CointEq(-1)*	-0.917407	0.099935	-9.180054	0.0000

Source: Author's own computation.

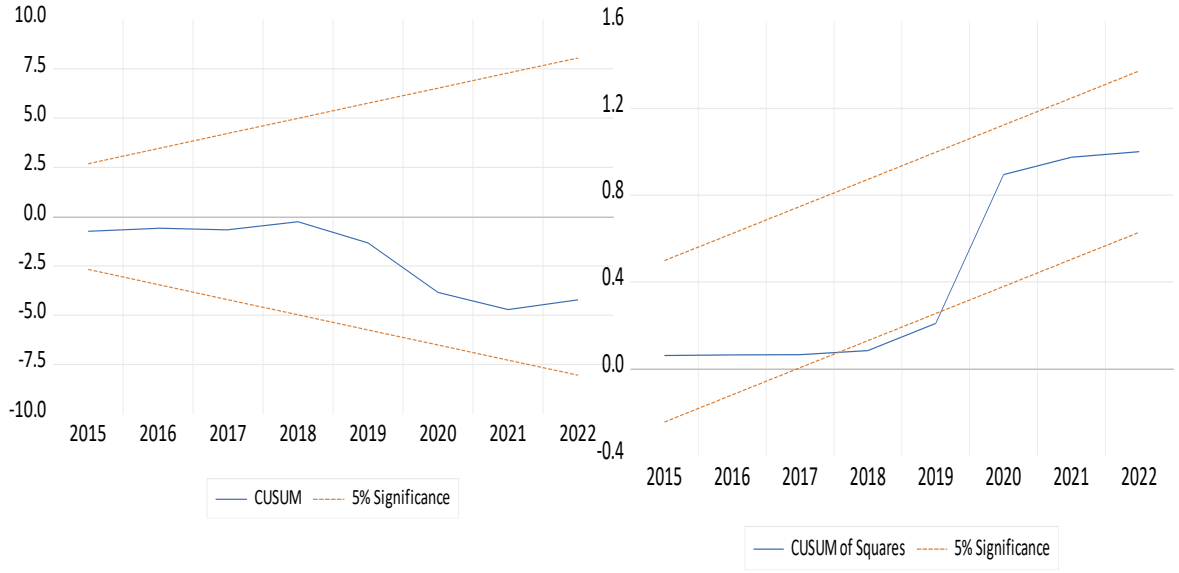
4.5 Diagnostic test results:

Table 7 presents the findings of the diagnostic assessments for the ARDL model. The Ramsy RESET test indicates that the model does not suffer from any misspecification issues. The Lagrange multiplier (LM) test shows that there is no presence of serial correlation. The Jacque-Bera test confirms that all residuals follow a normal distribution. Lastly, the Breusch-Pagan-Godfrey test concludes that our model does not exhibit a problem with heteroscedasticity. In summary, the results suggest that the model is robust, indicating the dynamic interrelationships among economic growth, public expenditure, gross capital formation, inflation, FDI inflows, labor force, and trade openness in Jordan over the years.

Table 7. Results of Diagnostic Tests

Test Statistics	F value	Prob.
RESET test	0.296	0.603
JB Test	0.373	0.829
LM Test	2.00	0.215
Breusch-Pagan-Godfrey	0.902	0.614

Stability Test:



5. CONCLUSION

The main aim of this study to test the interaction between economic growth and some macroeconomic variables (public expenditures, FDI, trade openness, gross capital formation, inflation, labor force), data from 1980 to 2022 employed, to achieve the study aim ARDL bounds test established that the study variables displayed long-run cointegration. According to the result of ARDL long run, interaction between economic growth and macroeconomic variables depicted in Table 5. Show that public expenditures, gross capital formation, labor force have positive impact on economic growth in Jordan within study period 1980-2022. This mean that the Jordan's growth influenced by domestic macroeconomic variables, however, foreign direct investment and trade openness do not have impact on Jordan's growth in long run.

Short run results that presented in Table 6. confirmed that public expenditures, low inflation rate, gross capital formation, labor force have positive impact on economic growth in Jordan over 1980-2022. Nevertheless, trade openness has negative impact on growth, this indicate that trade liberalization policies in Jordan leads to negative results. Finally, ECM sign is negative and statistically significant at 1% , it notifies us that 91% of all errors in short run is adjusted in next period.

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Exploring The Long Run Relationship Between Air Transport and Economic Growth in Japan: New Evidence

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Abstract

This study examines the long-term relationship between air transport and economic growth in Japan between 1980 and 2023. The autoregressive distributed lag ARDL model and the Granger causality test were used. The results of the bounds cointegration test revealed that all study variables are cointegrated. The long-term results showed that air transport passengers have a positive and statistically significant impact on economic growth, as well as financial development and urbanization. An increase of 1% in the number of air transport passengers contributes to a 0.08% increase in GDP per capita. The short-term results showed that energy use and urbanization have a positive impact on economic growth. Granger's causality results show that there is a one-way relationship from economic growth and financial development to air transport passengers, furthermore, there is a two-way relationship between air transport, energy consumption and the social globalization index. Based on these findings, and in light of the study's results, it is clear that giving great importance to the Japanese air transport sector and its development is a priority, given its positive impact on long-term economic growth.

Keywords: Air transport; economic growth; ARDL; Japan

Jel: C30; E43; L83

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1. INTRODUCTION

Air transport has expanded significantly in recent decades, as globalization and trade openness have played a major role in connecting countries around the world. This development has contributed to the revitalization of commercial activities. Comparative advantage in the tourism sector has a crucial role in developing the field of air transport, countries that enjoy sustainable economic growth have been able to develop their aviation industries in a way that serves the economy as a whole. Thoumrungroje and Tansuhaj (2007) as well as Čiarnienė and Kumpikaitė (2008) have established that advancements in transportation are a key outcome of globalization, which has drastically transformed business practices and increased the extent of globalization.

Cidell (2006) identified three main processes related to globalization that significantly affected air transportation: a surge in trade, advancements in technology, and deregulation. The notable influence of globalization plays a role in generating numerous job opportunities and fostering economic development. The aviation industry is particularly impacted by globalization due to its direct ties to the openness of nations worldwide. Additionally, the aviation sector is a vibrant field that is greatly shaped by contemporary innovations resulting from the integration of countries globally. Air travel has emerged as the most essential, dependable, and swift mode of transportation, propelled by globalization, which, along with deregulation and decreased airfare prices, combined with rising GDP and improved living standards, serves as a primary catalyst for the growth of the airline industry (Oktal et al., 2006). Further, globalization factors positively influence airlines' performance metrics concerning both operations and financial aspects (Kuz and Miskinis, 2021).

The air transport sector has direct, indirect and induced impacts on the wheel of economic growth, the direct impact is represented by employment through activities directly linked to the air transport sector. The indirect impact is through operational activities that provide goods and services, such as aviation fuel, construction, infrastructure, information technology, the financial sector, and other activities indirectly linked to the transport sector in general. The air transport sector has enabled many activities to increase productivity, facilitate trade and tourism development, improve efficiency, and attract investment (Allroggen and Malina, 2014). The induced impact signifies the multiplier consequence of direct and indirect impacts (Vasigh and Pearce, 2024: 20)

In the field of trade and tourism, the air transport sector has an essential role in terms of trade and tourism, facilitating global trade. Air freight is essential for enabling international trade by swiftly and efficiently moving goods across borders. The dynamics of global trade and globalization mechanisms have molded the aviation industry. Moreover, the air transport sector boosting Tourism, the increased availability

and affordability of air travel have significantly fueled the enlargement of international tourism, driving economic activity in host countries. Visitors traveling by air tend to spend on lodging, food, transportation, and attractions, thus energizing local economies and supporting small businesses (Thrane,2015; Njoya, 2020).

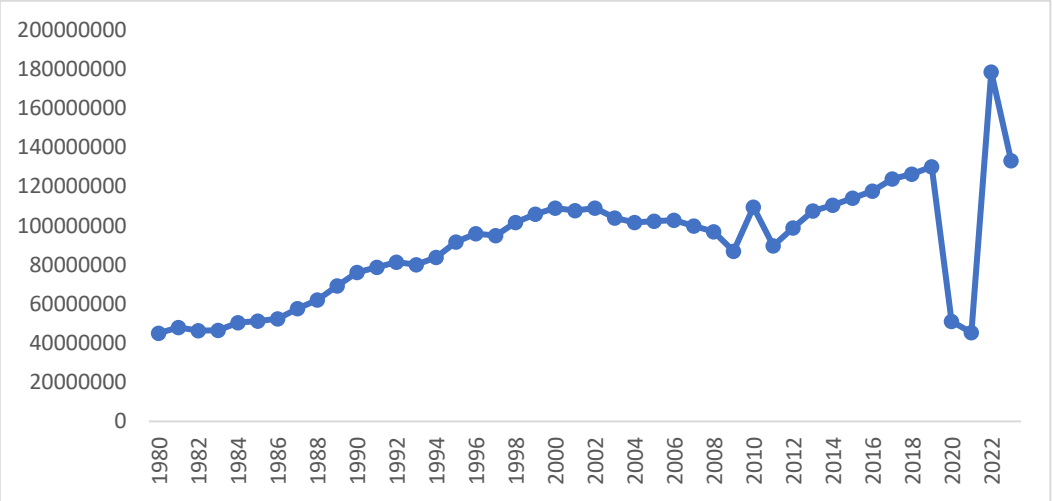
Finally, the air transport sector has a vibrant impact on Economic progress and Connectivity, the aviation sector links businesses with suppliers, customers, and partners across the globe. It raises innovation and cooperation on an international level, with business travelers relying on air transportation for meetings, conferences, and exhibitions, thus inducing economic flexibility and competitiveness. Regional Connectivity: Airports act as hubs for regional connections, linking remote and underserved areas with urban centers and global markets. Access to air travel improves mobility, supports trade, and enhances access to vital services, thereby contributing to the socioeconomic growth of rural communities (Brugnoli et al,2018).

The World Travel and Tourism Council reported that in 2024, the tourism industry inject global economy by US$10.9 trillion, representing 10% of the global gross domestic product. It is projected that by 2034, this sector will contribute a remarkable $16 trillion, which will account for 11.4% of the world economy. Furthermore, this growing sector is expected to provide jobs for 449 million individuals worldwide, making it a major source of employment. This underscores the vital importance of travel and tourism in global employment, as about 12.2% of the worldwide workforce is engaged in this dynamic industry.

The transportation sector in Japan is considered one of the most important sectors, as Japan has 98 airports that provide air transport services. The development of this sector has been contributed to by many factors, whether external, such as openness and globalization, or internal, due to urbanization, economic growth, and geography, which has witnessed significant development over the past decades. The Japanese aviation market is anticipated to expand from its 2024 valuation of USD 10.49 billion to USD 13.35 billion by 2029, with an annual growth rate of 4.94% from 2024 to 2029 (WTTC, 2025).

Regarding the development of air transport in Japan, the number of air transport passengers in 1980 reached 45 million, this sector continued to grow significantly and reached 130 million in 2019. Between 2020-2021, there was a clear decline in the number of passengers due to Covid-19. After the end of the epidemic, the air transport market returned to its normal level. This explains that the Japanese air transport sector is a dynamic and vital sector for economic activity. Figure (1) shows the development of Japanese air transport passengers (AT) during the period between 1980-2023.

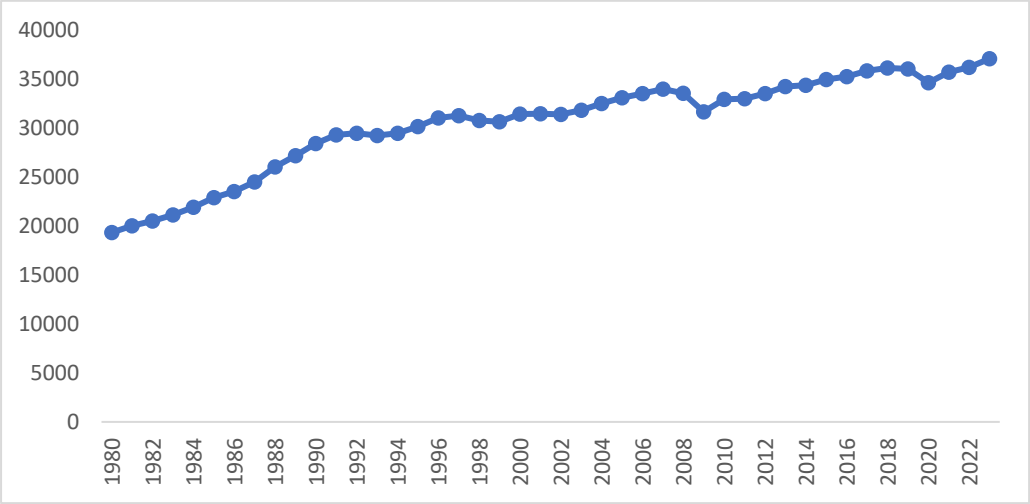
Figure 1. The development of Japanese air transport passengers during the period between 1980-2023.



Source: World Bank.

The Figure 2 shows that there is a balanced growth in Japanese GDP per capita during the study period. In 1980, the per capita GDP was equivalent to USD 19334.4, this growth continued until 2008, when Japan was affected by the global financial crisis GDP per capita fell slowly. After that, it rose again until the Covid-19 crisis, after which it rose again. This development in the GDP per capita output indicates that the Japanese economy is significantly affected by global economic conditions, which are reflected in the integration degree of Japanese economy in worldwide economy. Figure (2) shows the direction of the development of output during the period between 1980-2023.

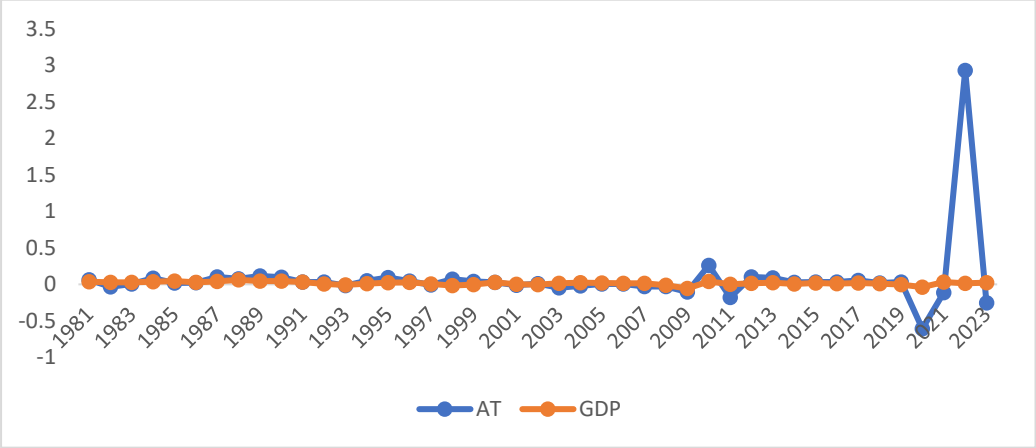
Figure 2. The development GDP per capita trend during the period between 1980-2023.



Source: World Bank.

It is noted from Figure (3) that the growth rate in the number of air passengers transport and the GDP Per capita growth rate during the study period are moving at the same level, which indicates that Japanese air transport has a strong relationship with economic growth. In 2022, after recovering from Covid-19, air transport witnessed a significant increase not only in Japan but also globally as a whole. The air passengers transport average growth rate during the study period was 0.071, while GDP Per capita average growth rate was 0.015, meaning that the growth in air passengers transport is higher than the economic growth, which indicates that the impact of air transport is positive on Japanese economic growth due to induced impact.

Figure 3. The Japanese growth rate of air transport passengers (AT) and GDP per capita from 1981 to 2023.



Source: Obtained based on World Bank open data. 2024.

2. LITERATURE REVIEW

Numerous studies have addressed the role of air transport in economic growth. Some of these studies have found that air transport has a positive impact on economic growth, while others have found the opposite. Kiracı and Bakır (2019) investigated the causal links between air transportation and economic growth, taking income levels into account. Regarding this analysis, high-income, upper-middle-income, lower-middle-income, and low-income countries have been included. Data collected from 1990 to 2016, a total of 70 countries were categorized by their income levels and analyzed quantitatively. The study employed panel causality tests as developed by Kónya (2006) and Emirmahmutoğlu & Köse (2011). The results show that the rise GDP has a significant impact on air transport. In addition, they suggest that the nature of the unidirectional or bidirectional causal relationships between GDP and air transport differs according to the income level of each country.

Hakim and Merkert (2016) exposed the causal link between air transportation and economic development in South Asia. Panel data spanning 42 years (1973–2014) was employed, the study used Pedroni/Johansen cointegration testing techniques, Granger long-run, and Wald short-run causality examinations. To account for spatial

differences, we applied Time Series cross-section (TSCS) Granger causality tests for each of the eight countries analyzed individually. Our findings indicate a long-term uni-directional Granger causality from GDP to air passenger traffic as well as to air freight volumes. In contrast to previous studies, we did not identify a long-term bi-directional causality, emphasizing the relevance of spatial factors and context (particularly in low-income regions with large populations). The lack of short-run causality and the identified time lags of 3–4 years should inform aviation companies and policymakers when planning the necessary infrastructure to accommodate the significant potential for growth in air transport.

Rodríguez-Brindis et al. (2015) diagnosed the long-term effects between air transport demand and economic growth in Chile. Using quarterly data from 1986 (Q1) to 2014 (Q29), Using Johansen cointegration, the existence of a cointegration vector is demonstrated in which the corresponding elasticities are positive. The result displayed that there is a positive and bidirectional causal relationship.

Additionally, Brida et al. (2016a) studied the relationship between air transport demand and economic growth in Italy from 1971 to 2012. utilizing Johansen co-integration analysis. The results reveal that the elasticities were determined to be positive. The Granger Causality test identified a unidirectional causal link from air transportation to GDP. These results imply that Italy could boost its economic growth by effectively utilizing the air transport sector and improving its governance capabilities. In a similar vein, Brida et al. (2016b) explored the causal relationships between real GDP and the number of air passengers arriving at and departing from airports in Mexico. Their Johansen co-integration analysis also indicated one cointegrated vector with positive elasticities. The study revealed a positive and bidirectional causal relationship. The impulse response analysis suggested that an increase in the scale of air transport development in Mexico promotes the country's economic growth.

Baltaci et al. (2015) inspected the relationship between air transport and economic growth in Turkey. A cross-regional panel data analysis approach. The results of this study show that there is a positive relationship between the number of energetic airports, frequency of air traffic, and regional economic growth. Balsalobre-Lorente et al. (2020) presented evidence of an uneven relationship between air travel and economic growth within the Spanish economy from 1970 to 2015; they highlight the positive influences of social globalization and urbanization on Spain's economic progress. Gómez et al. (2018) examined the causal relationship between energy consumption and income in Mexico from 1965 to 2014, uncovering structural breaks in the data. Results signified a long-term interaction among production, labor, capital, and energy.

Gurgul and Lach (2011) used quarterly data from Poland to analyze the link between coal consumption and the economy, using GDP as a standard and incorporating employment as a variable. Their findings indicated a nonlinear causality between coal consumption and GDP, as well as other interrelations, and while they applied the Toda-Yamamoto bootstrap methods, employing quarterly data may have uncovered more latent patterns within the data. Onifade et al. (2022) examined the importance of the tourism-induced growth hypothesis regarding air transport across seven emerging (E7) nations—China, India, Brazil, Mexico, Russia, Indonesia, and Turkey. They utilized second-generation panel data estimators, including cross-sectional autoregressive distributed lag, augmented Mean Group, and Dumitrescu-Hurlin Causality techniques, and established a long-run equilibrium relationship among the specified variables,

validating the critical role of air transport in promoting economic growth, as a one percent increase in airline passenger arrivals significantly boosts growth in the E7 nations by 0.77%.

Khanal et al. (2022) inspected the impact of air transport on economic growth in Australia in both the long-run and short-run. Employed the nonlinear autoregressive distributed lag (NARDL) modeling approach on data from Australia dating from 1971 to 2019, and also explored the impact of selected control variables (such as energy consumption, financial development, socialization, and urbanization) on economic growth. Results indicated statistically significant asymmetric effects of air transport on economic growth in both the short and long run. Positive variations in air transport foster long-term economic growth in Australia, while adverse changes in air transport have a more pronounced negative effect on economic progression than their positive counterparts.

Mehmood et al. (2014) tested the aviation-led growth hypothesis in Romania by investigating the causal relationship between aviation and economic development. they utilized econometric tests, including unit root tests and Johansen's (1988) cointegration tests. Fully Modified OLS, Dynamic OLS, and Conical Cointegration Regression methods are used to estimate the cointegration equation over the period from 1970 to 2012. The empirical findings indicate a cointegration relationship between aviation demand and economic growth. Additionally, graphical techniques such as the Cholesky impulse response function (both accumulated and non-accumulated) and variance decomposition have been employed to enhance the analysis's robustness. The positive impact of aviation demand on economic growth is consistent across all three estimation methods of the cointegration equation. Finally, a Granger causality test is conducted to determine the direction of the causal relationship. The results underscore the significance of the aviation sector in contributing to economic growth in Romania.

Destek and Aslan (2017) utilize bootstrap Granger causality analysis, revealing that there is a connection between energy consumption and economic growth. Fang and Chang (2016) investigate the causal link among energy, human capital, and economic growth. Saidi and Mbarek (2016) analyze the interaction between nuclear energy, renewable energy, CO2 emissions, and economic growth across nine developed nations. Chang et al. (2014) confirmed the causal relationship between nuclear energy consumption and economic growth in G6 countries.

Li (2015) discovered that the advancement of civil aviation contributed positively to economic growth. Shen and Zou (2016) demonstrated that there was a bidirectional Granger causality between air transportation and the economy in China, finding indicated that, economic growth promotes air transport growth more significantly than vice versa.

Lu and Li (2016) revealed a stable long-term equilibrium relationship between aviation mileage and national income levels in China. Button and Yuan (2013) discovered the causal relationship between air freight transport and economic development, concluding that airfreight transport positively influences local economic growth. Fernandes and Pacheco (2010) investigated the causal relationship between GDP and air passenger traffic, establishing a unidirectional Granger causality from economic growth to domestic air transport demand. Vijver et al. (2015) assessed the connection between air transport and regional development in Europe, using employment as a

reliable and measurable indicator of regional development. The methodology focused on whether air transport causally impacts employment and vice versa, revealing that both causal directions exist in European urban areas. Furthermore, Hu et al. (2015) explored the short-run dynamics, long-run equilibrium relationships, and Granger causal associations between economic growth and domestic air passenger traffic, based on quarterly panel data from 29 provinces in China over the period from 2006Q1 to 2012Q3. They used tests for panel unit roots, cointegration in heterogeneous panels, and panel causality within a bi-variate panel vector error correction model (PVECM) estimated by the system generalized moment method (SYS-GMM). The findings provide evidence of a long-run equilibrium relationship between economic growth and domestic air passenger traffic, specifically noting that a 1% increase in air passenger traffic corresponds to a 0.943% rise in real GDP. A strong long-run bi-directional Granger causal relationship was identified between these two series, along with a short-run unidirectional Granger causality flowing from domestic air passenger traffic to economic growth.

Cruz-Rodríguez, and Rodríguez-Flores (2019) investigated the causal link between economic growth and air passenger transportation in Mexico from 2003 to 2017. They employed cointegration analysis through Pedroni and Johansen tests, vector error correction models, and the Granger causality test. Their findings show that an increased traffic volume affects the direction of causality. Fernandes et al. (2021b) used a Granger causality analysis to examine the relationship between domestic air passenger transport and the GDP of small regional municipalities in the Amazon region of Brazil. The outcomes of their analysis reveal a bidirectional relationship between the economy and air transport both in the short and long term.

This study aims to explore the long-run relationship between air transport passengers and economic growth in Japan from 1980 to 20213. To avoid model errors, control variables are used, such as financial development, Urbanization, energy use, and social globalization Index.

3.DATA, MODEL SPECIFICATION AND METHODOLOGY

3.1 Data

This study employs time series data from 1980 to 2023 for Japan, which formed the groundwork for the analysis. Data concerning GDP per capita, air transport passengers carried, energy usage, financial progress, and urbanization were obtained from the World Development Indicators (WDI). Furthermore, details regarding the social globalization index were gathered from the KOF Swiss Economic Institute. The KOF Globalization Index assesses economic, social, and political dimensions of globalization (KOF, 2023) and consists of 12 economic indicators related to banking confidence, production levels, new orders, consumer sentiment, and housing. Table 1 presents the sources of data and descriptions of the variables.

Table 1. Data sources and variable description

Variables	Description	Source
Gross domestic product (GDP)	GDP per capita (current USD)	WDI
Air transport (AT)	Air transport, Passengers carried	WDI
Energy use (EU)	Primary energy uses per capita	WDI
Financial development (FD)	Domestic credit to the private sector (%GDP)	WDI
Social globalization (SG)	Social integration index	KOF
Urbanization growth (UR)	Urban population growth (annual %)	WDI

The data in Table 2 presents descriptive statistics for a set of variables. It was found that the mean of the variables falls within the expected range, indicating the absence of outliers in the dataset. However, the calculated standard deviations suggest that there is a considerable amount of variability in the data. Furthermore, all the analyzed parameters exhibit negative skewness, with none exceeding the range limit of +1 and -1. The resulting Kurtosis value for each parameter is less than 3, indicating normal distribution. The Jarque-Bera test confirms the normal distribution of the parameters. Consequently, the researcher was able to utilize the data for further analysis.

Table 2. Descriptive statistics

Variables	Mean	Median	Max	Mini	Std. Dev.	Skewness	Kurtosis	JB	Prob.
L(GDP)	10.311	10.356	10.52	9.87	0.177	-1.131	3.216	9.47	0.009
L (AT)	18.263	18.385	19.00	17.66	0.351	-0.498	2.306	2.70	0.257
L (FD)	5.142	5.1348	5.38	4.82	0.135	-0.439	2.760	1.52	0.468
L (SG)	4.219	4.2520	4.37	4.06	0.114	-0.232	1.381	5.20	0.074
L (EU)	10.669	10.679	10.81	10.45	0.108	-0.365	2.033	2.69	0.260
L (UR)	4.422	4.3921	4.52	4.33	0.078	0.191	1.222	6.06	0.048
L (FD)	5.142	5.1348	5.38	4.82	0.135	-0.439	2.760	1.52	0.468

3.2 Model

In economics, forecasting long-term relationships is an essential tool that helps economic decision-makers adopt policies and plans that promote economic growth and lessen obstacles. Today, the aviation industry is one of the inputs to economic growth, it is linked to many other macroeconomic variables such as financial sector and energy consumption, especially in light of the abandonment of traditional means of transportation and the transition to air transport. Following Balsalobre-Lorente et al. (2021), Marazzo et al. (20210), Adedoyin et al. (2020), Wang et al. (2019), a functional equation of the model is presented as:

$$GDP = f(AT, EU, FD, SG, U) \quad (1)$$

$$GDP_t = \beta_0 + \beta_1 AT_t + \beta_2 EU_t + \beta_3 FD_t + \beta_4 SG_t + \beta_5 U_t + \varepsilon_t \quad (2)$$

Where β_0 and ε_t are the intercept and the error term respectively. In addition, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ represents the coefficients. By taking the natural logarithm of equation (2), the study model becomes as following equation:

$$LGDP_t = \beta_0 + \beta_1 LAT_t + \beta_2 LEU_t + \beta_3 LFD_t + \beta_4 LSG_t + \beta_5 LU_t + \varepsilon_t \quad (3)$$

3.3 Methodology

The main aim of this research was to assess the applicability of the Aviation-Led growth Hypothesis (ALGH) in the context of Japan by examining the relationships between air transport and economic growth over both short and long terms using an ARDL model proposed by Pesaran et al. (2001). Moreover, this study incorporated several explanatory variables, such as energy consumption, financial development, social globalization, and urbanization, as control variables to avoid the potential for biases due to omitted variables. The significant increase in air travel can mainly be attributed to the rise of globalization. As global connectivity expands, there is a rising need for air transportation to facilitate international trade, tourism, and cultural interactions. Therefore, social globalization significantly influences air transport, alongside energy use and financial development. The ARDL framework allows for the investigation of cointegration between variables over both short and long term. This method presents multiple benefits compared to traditional cointegration techniques (Voumik et al., 2023). Unlike earlier cointegration methods, it does not require the integration property of a series to be tested beforehand. The ARDL model addresses endogeneity by incorporating the lag length of the variable. It is also applicable to any situation involving the integration of an exploratory series (Yusoff et al., 2023). The ARDL model maintains statistical significance even with limited sample sizes. Therefore, the ARDL cointegration method enables an accurate estimation of the long-term relationships among variables. When the independent variables are either I(0) or I(1), the ARDL bound test provides two asymptotic critical value bounds. The equation (4) was used to estimate the cointegration among a set of variables.

$$\Delta LGDP_t = \beta_0 + \beta_1 GDP_{t-1} + \beta_2 LAT_{t-1} + \beta_3 LEU_{t-1} + \beta_4 LFD_{t-1} + \beta_5 LSG_{t-1} + \beta_6 LU_{t-1} + \sum_{i=1}^{q} \gamma_1 \Delta GDP_{t-i} + \sum_{i=1}^{q} \gamma_2 \Delta LAT_{t-i} + \sum_{i=1}^{q} \gamma_3 \Delta LEU_{t-i} +$$

$\sum_{i=1}^{q} \gamma_4 L\Delta FD_{t-i} + \sum_{i=1}^{q} \gamma_5 \Delta LSG_{t-i} + \sum_{i=1}^{q} \gamma_6 \Delta LUR_{t-i} + \varepsilon_t$
(4)

After establishing the long-term relationship between the series, it is important to consider the short-term coefficient. This research assessed the error-correction model (ECM) using Equation (5) and calculated the short-term coefficients. Equation (5) demonstrates the dynamics of error correction and the long-term connections between the series.

$\Delta LGDP_t = \beta_0 + \beta_1 GDP_{t-1} + \beta_2 LAT_{t-1} + \beta_3 LEU_{t-1} + \beta_4 LFD_{t-1} + \beta_5 LSG_{t-1} + \beta_6 LU_{t-1} + \sum_{i=1}^{q} \gamma_1 \Delta GDP_{t-i} + \sum_{i=1}^{q} \gamma_2 \Delta LAT_{t-i} + \sum_{i=1}^{q} \gamma_3 \Delta LEU_{t-i} + \sum_{i=1}^{q} \gamma_4 L\Delta FD_{t-i} + \sum_{i=1}^{q} \gamma_5 \Delta LSG_{t-i} + \sum_{i=1}^{q} \gamma_6 \Delta LUR_{t-i} + \theta ECM_{i-1} + \varepsilon_t$
(5)

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.

4. EMPIRICAL RESULTS

4.1 Lag selection

In Table 3, the findings of the optimal lag selection are displayed. Identifying the best lag in the ARDL model aims to address the issue of autocorrelation within the model system by treating the lag in endogenous variables as an exogenous variable. The optimal lag determination is based on the likelihood ratio (LR), final prediction error (FPE), AIC, Schwarz information criterion (SIC), and Hannan–Quin criterion (HQ) values. As indicated in Table 2, the chosen lag is lag 2 as the optimal lag implies that all variables not only influence each other in the same period but also in the preceding two periods.

Table 3. Lag selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	315.4468	NA	1.12e-14	-15.09496	-14.84420	-15.00365
1	623.7200	511.2824	1.95e-20	-28.37659	-26.62122	-27.73738
2	715.1284	124.8505*	1.47e-21*	-31.07943*	-27.81947*	-29.89233*
3	749.2488	36.61699	2.22e-21	-30.98774	-26.22318	-29.25275

4.2 Unit root tests

Before engaging in a cointegration test, it is essential to perform unit root tests to assess the stationarity characteristics of the parameters. This step is vital as it aids in selecting an appropriate test for the subsequent phase of the study and identifies the type of

stationarity of the parameters being analyzed. Two-unit root testing methods were implemented in this study: Augmented Dickey-Fuller and Phillips-Perron. As shown in Table 4, all parameters evaluated displayed stability at the level I(0) or after the first difference I(1). This indicates that cointegration and the ARDL estimator can be utilized with the data.

The stationarity of the variables was assessed at the outset of the time series analysis through the use of unit root tests. Utilizing unit root testing can help avoid erroneous regression analyses (Ridzuan et al., 2017). This process involves examining the regression variables to determine their stationarity and then employing those stationary processes to estimate the target equation. According to existing empirical literature, it is essential to establish the integration sequence before applying cointegration techniques.

The unit root test was used to analyze the stationarity of the featured variables. If the mean-variance and covariance of a variable's probability distribution changes over time, it is considered non-stationary (Borhan et al., 2023). Considering the variations in power and sample size across the tests, several researchers have suggested the use of multiple unit root tests to determine the series' integration order. Three-unit root test were used, the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979), DF-GLS and the Phillips-Perron (P-P) (Phillips and Perron, 1988) were employed to determine the stationarity of the variables.

Table 4. The results of unit root tests

	ADV		DF-GLS		PP	
	At level	First difference	At level	First difference	At level	First difference
L (GDP)	-4.027***	-4.547***	0.397	-4.124***	-4.125***	-4.534***
L (AT)	-2.270	-10.108***	-1.0242	-10.218***	-2.627*	-15.690***
L (FD)	-2.433	-4.079***	-1.011	-4.087***	-2.275	-4.035***
L (EU)	-1.350	-6.506***	-0.910	-5.705***	-1.429	-6.614***
L (UR)	-1.415	-2.025	-1.158	-1.974**	-0.260	-1.763
L (SG)	-0.549	-5.729***	0.866	-5.786***	-0.559	-5.739***

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

4.3 Cointegration Test

The dataset's stationarity can be assessed based on the outcomes of the unit root test. To investigate whether a cointegration relationship existed between the parameters in use, the ARDL Bounds test was conducted. Table 5 displays the results of the cointegration analysis. The obtained cointegration F-statistic (13.478, refer to Table 5) exceeds the upper acceptable value. This test establishes that the study variables are cointegrated.

Table 5. ARDL bounds test results

Null hypothesis: No degree of relationship					Result
		Sig.	I(0	I(1)	
F value	13.478	10%	2.08	3	Cointegrated ***
K	5	5%	2.39	3.38	
		2.5%	2.7	3.73	
		1%	3.06	4.15	

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

4.4 Model estimation

Table (6) shows that the long-term results show that a 1% increase in the number of air transport passengers contributes to a 0.08% increase in GDP per capita. This means that increased air transport has a positive and statistically significant effect on economic growth in Japan. The results also show that a 1% increase in financial development contributes to a 0.45% increase in GDP per capita. Financial development has a positive effect on the transportation and tourism sectors. Regarding urbanization growth, the results show that a 1% increase in urbanization contributes to a 1.7% increase in GDP per capita. In the short term, the results show that a 1% increase in energy consumption contributes to a 0.065% increase in GDP, in addition, an increase a 1% increase in urbanization contributes to a 0.53% increase in GDP per capita.

Table 6. Long and short run results

Variable	Long run		Short run	
	coefficients	Prob.	Coefficients	Prob.
L (AT)	0.083795	0.0053***	0.000904	0.8431
L (FD)	0.454812	0.0000***	0.017367	0.5475
L (SG)	-0.027793	0.8790	-0.008475	0.8797
L (EU)	0.126489	0.1294	0.648864	0.00***
L (UR)	1.766150	0.0000***	0.538561	0.0002***
c	-2.587943	0.0128	-	-
ECM	-	-	-0.304935	0.00***

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

The ECM value mirrors the speed at which the system moves from a temporary balance to a state of permanent stability. Both the coefficient and the derived ECM are negative at the 1% significance level. According to the ECM values, short-term deviations from the long-term equilibrium path are generally adjusted by an average of 53.49 %, 4. The negative and significant ECM coefficient indicates that any long-term disparities among the model variables will adjust or align with the long-term equilibrium.

4.5 Granger Causality Test

Granger's causality results in Table (7) show that there is a one-way relationship from economic growth and financial development to air transport passengers, furthermore, there is a two-way relationship between air transport, energy consumption and the social globalization index (Granger, 1969).

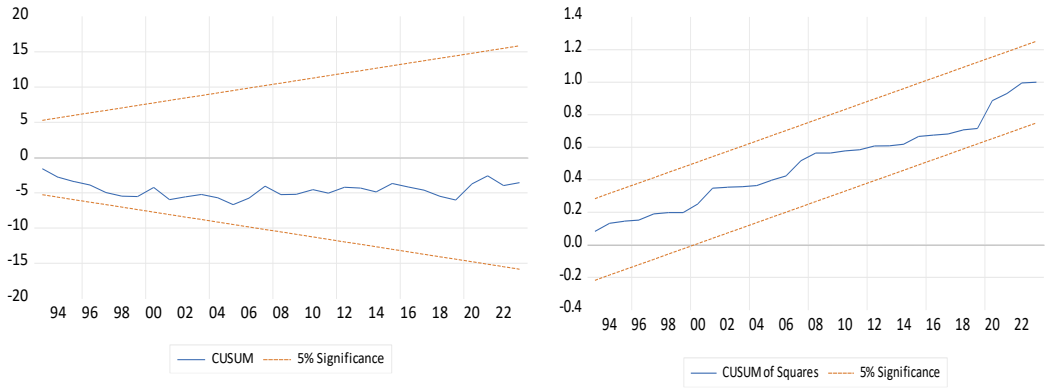
Table 7. Granger causality results

Null Hypothesis:	F-Statistic	Prob.
L (AT) does not Granger Cause L (GDP)	1.42139	0.2543
L (GDP) does not Granger Cause L (AT)	10.0106	0.0003***
L (AT) does not Granger Cause L (FD)	0.23549	0.7914
L (FD) does not Granger Cause L (AT)	4.42244	0.0190**
L (AT) does not Granger Cause L (EU)	3.66756	0.0352**
L (EU) does not Granger Cause L (AT)	2.80573	0.0734**
L (SG) does not Granger Cause L (AT)	3.29927	0.0480**
L (AT) does not Granger Cause L (SG)	4.99690	0.0120**

4.6 CUSUM and CUSUMQ Tests

The CUSUM test depends on the total recursive sum of the recursive residuals, whereas the CUSUMSQ test is based on the cumulative sum of the squares of the recursive residuals (Brown et al., 1975).

Figure 4. CUSUM and CUSUMQ Tests



4.7 Diagnostic tests

The reliability of the ARDL results was assessed through various diagnostic tests. Table 8 presents the Breusch-Godfrey Lagrange Multiplier (LM) test for autocorrelation, showing no evidence of serial correlation. The Breusch-Pagan-Godfrey test indicated the absence of Heteroscedasticity in the data. The Jarque-Bera Normality test confirmed that the residuals follow a normal distribution based on the Jarque-Bera statistic and p-value.

Table 8. Results of diagnostic tests

Diagnostic tests	Coef.	Prob.	Decision
Jarque-Bera test	0.313	0.855	Residuals are normally distributed
Breusch-Godfrey Serial Correlation LM Test:	1.446	0.2519	No serial correlation exists
Breusch-Pagan-Godfrey	1.008	0.4587	No heteroscedasticity exists
Ramsey Reset test	0.220	0.642	The model is properly specified

5. CONCLUSION

The Japanese aviation sector is considered one of the vital sectors that contribute to supporting economic activities. Japan, with its unique geographical location and islands areas, imposes great importance on air transport. This study aimed to identify the long-term relationship between air transport and economic growth, during the period from 1980 to 2023. Was relied upon as it is the most appropriate standard test to discover the long-term relationship ARDL. The results showed, based on the cointegration bounds test, that there is cointegration between the variables of the standard model. The long-term results showed that air transport has an impact on economic growth in Japan, an increase a 1% increase in air transport contributes to increase in GDP per capita by 0.08%. The results also showed that financial development (Domestic credit to private sector % GDP) and urbanization contribute to supporting economic growth. In the short term, the results showed that energy consumption and urbanization have a statistically significant impact on economic growth. Finally, the results of the Granger causality test indicated that there is a one-sided relationship from economic growth to air transport, as well as a one-sided relationship from financial development to air transport. On the other hand, it was shown that there is a two-way relationship between air transport and both energy consumption and the social globalization index.

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