Journal of Economics, Finance and Management Studies

ISSN (print): 2644-0490, ISSN (online): 2644-0504

Volume 07 Issue 07 July 2024

Article DOI: 10.47191/jefms/v7-i7-73, Impact Factor: 8.044

Page No: 4561-4573

Research and Development-Driven Foreign Direct Investment and Its Ramifications on Turkey's Economic Landscape: A VECM Approach"

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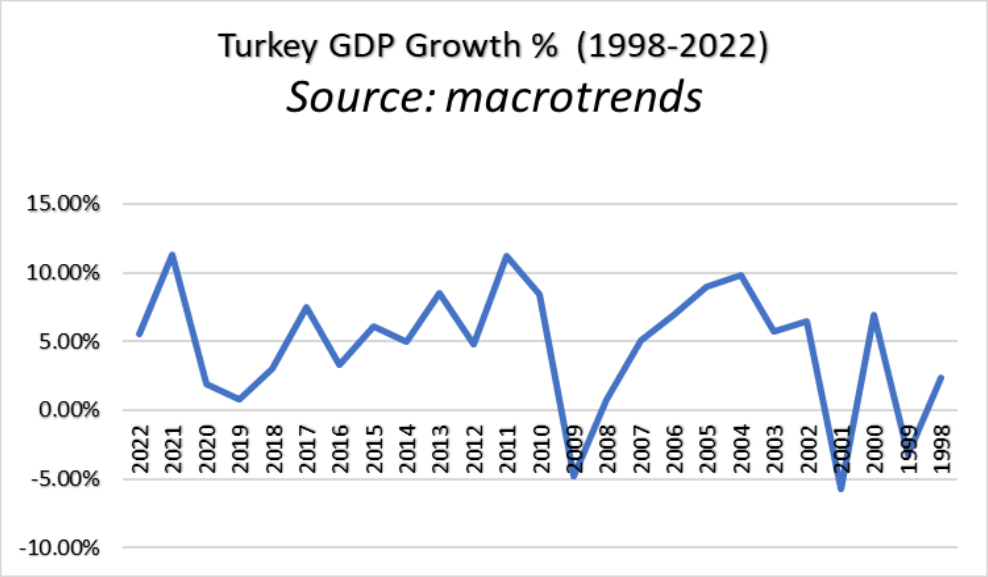
ABSTRACT: The purpose of this study is to empirically investigate the impact of research and development on economic growth in Turkey. Data for this study comes from the popular World Development Indicator spanning the period from 1973 to 2022. The study employed different econometric approaches such as ADF unit root, Granger causality, and VECM. The estimate of the Johansen test revealed that there is a long-run relationship among the variables as the trace test shows two cointegrations while the maximum Eigenvalue Test indicates one cointegration test result. The Granger Causality test indicates that there is a presence of causality, which runs from economic growth to the independent variables. Turkey's diverse economies account for the variations in the estimated findings of the impulse response and variance decomposition. Furthermore, the study's conclusions suggest that the Turkish government boost its R&D spending in order to promote economic expansion. Turkey can achieve sustainable economic development by putting policies in place that reward innovation and technological advancements. The potential for economic growth in the nation can also be increased by encouraging cooperation in R&D projects between the public and private sectors.

KEYWORDS: FDI, R&D, Export, Trade, Turkey, VECM

1. INTRODUCTION

Countries have realized that innovative approaches are critical for economic advancement in today's fast-paced global environment. The value of research and development in advancing technical expertise is widely recognized, and foreign direct investment acts as a conduit for international technology transfer. According to (Crespo & Fontoura, 2007), countries regard foreign direct investment as a means of securing funds for investments in developed and developing nations.

Nations actively endorsing R&D spending, as suggested by (Flechas et al., 2023), can sustain long-term growth. In pursuit of such transformation, Turkey increased the share of R&D investments to 2% within the overall public budget by 2020, as outlined by the Republic of Türkiye Investment Office (2022). In 2018, Turkey established the Ministry of Industry and Technology concerning R&D. This initiative resulted in a remarkable surge, as depicted in the GDP growth rate graph below, escalating from 1.94% in 2020 to 11.5% in 2021. Additionally, the Republic of Türkiye Investment Office (2022) reported that foreign direct investment (FDI) inflows into Turkey reached USD 14.1 billion in 2021, representing an astounding 81% year-over-year increase and contributing to a cumulative total of USD 239 billion from 2003 to 2021. The advancement brought about by Turkey's persistent efforts in research and development is partially responsible for these noteworthy economic accomplishments.



Building upon the insights of Silvia (2015), R&D investments significantly contribute to economic growth. Moreover, countries that allocate a substantial share to R&D expenditures often wield considerable influence in the world economy, as Tuna et al. (2015) noted. In the context of this relationship, this paper aims to investigate the impact of R&D activities related to foreign direct investment (FDI) on Turkey's economic growth.

Similarly, a study conducted by (Usman et al., 2012) found out that exports, government spending, and education spending all have a major influence on the developed economy of Luxembourg, an EU member state. According to his experimental findings, there is a strong positive correlation between economic growth and exports, government expenditures, and educational spending. Export also demonstrates that a one-unit increase in exports results in .17 positive improvement in economic growth. According to this, the nation benefited from the expansion in exports between 1975 and 2009, which was seen in both government and educational spending. A study was also undertaken between 2006 and 2015 by (Mtaturu, 2016) using a theoretical and Turkish framework. Based on his findings, the relationship between export and growth is unidirectional, with total export driving growth in the Turkish economy, while total import has no causal association with economic growth. As other economies have discovered, foreign commerce is an inevitable byproduct of globalization, and Turkey's economy has benefited from its contacts with foreign markets.

Furthermore, (Keho, 2017) found that trade openness has a favourable impact on economic growth in both the short and long term, based on a case study conducted in Côte d'Ivoire. According to him, a nation's free trade policies and the creation of flexible trade regulations will promote economic growth. Trade openness, on the other hand, has a favourable and complimentary relationship with capital development, which has an impact on strengthening the economy. (Iyoha & Okim, 2017) used panel data to study how trade affects economic growth in ECOWAS nations. His findings indicate that in each of the equations, investment, exports, and exchange rates had a major impact on the increase in real income per capita. . Exports continuously showed a positive relationship with growth, supporting the theory that trade significantly boosts economic growth in ECOWAS nations. Comparably, ECOWAS nations that support free and open trade internationally will also support member state economic development, taking into account the ways that interregional commerce has improved the standard of living and the economies of many other parts of the world.

Within the context of existing research, which has predominantly focused on either the effects of foreign direct investment on economic growth or the role of research and development in the economy's development, a notable gap emerges in comprehending how foreign direct investments, driven by research initiatives, contribute to the overall economic development of Turkey. This paper addresses this gap and sheds light on how research and development within foreign direct investment influence Turkey's economic growth. Consequently, the following research questions will be addressed:

1. How does research and development in foreign direct investment boost Turkey’s economic growth?
2. In what specific ways do foreign direct investments resulting from research and development initiatives contribute to Turkey's overall economic development?

2. LITERATURE REVIEW

This investigation addresses a critical gap in the existing literature by examining the impact of Research and Development within Foreign Direct Investment on Turkey's economic growth. Despite extensive research on foreign direct investment and the broader role of research in economic development, the specific contribution of Research and Development within Foreign Direct Investment has been insufficiently explored. Turkey, undergoing substantial economic transformations, serves as a distinctive case study, offering insights into how research and development within foreign direct investment can contribute to economic diversification and resilience, reducing vulnerability to challenges like inflation and natural disasters. The paper will answer three key questions: How does research and development in foreign direct investment enhance Turkey's economic growth, what specific contributions do they make to overall economic development, and how can policymakers effectively leverage these contributions for resilient economic growth?

2.1. Dynamics Of Research And Development Within Foreign Direct Investment

Research and development within Foreign Direct Investment plays a crucial role in fostering economic growth by facilitating technology exchange, knowledge dissemination, and advancing human capital. Aligned with the Knowledge Spillover theory, multinational enterprises investing in R&D activities within host countries bring advanced technologies and managerial practices, initiating technology transfers that enhance the host country's capabilities. The study by (Guloglu & Tekin, 2012) in Turkey and OECD countries enriches the discourse on Knowledge Spillover theory, providing empirical insights into the relationship between research and development expenditures, innovation, and economic growth. Utilizing VAR models and the Generalized Method of Moments, they find that research and development expenditures drive technological innovations, with output growth influencing technological advancements.

Similarly, (Sugiharti et al., 2022) study on China reveals a positive influence of FDI on technological innovation across 31 provinces from 2010 to 2019. The research underscores the idea that FDI contributes to knowledge spillovers and innovation, emphasizing the pivotal role of education, human capital, and regional resource endowment in shaping innovation capabilities. These findings provide tangible evidence that investments in R&D activities, a key aspect of FDI, contribute to the dissemination of knowledge and technology within host countries, aligning closely with the principles of Knowledge Spillover theory.

2.2. Multiplier Effect Of R&D Within Fdi On Economic Growth

The multiplier effect of Research and Development within Foreign Direct Investment catalyzes robust economic growth, creating high-skilled jobs and elevating the local workforce's proficiency. These investments facilitate the transfer of advanced technologies and knowledge, nurturing a highly skilled human capital base and fostering heightened productivity (Lucas, 1988). Aligned with the investment development path theory, which emphasizes the role of R&D, mainly when directed towards FDI, across various stages of investment, including technology transfer and innovation, (Karahan & Çolak, 2024) study in Turkey delves into the impact of FDI on technology transfer and innovation, revealing a positive correlation. It underscores that FDI, specifically with an R&D focus, substantially contributes to technology transfer and innovation in the Turkish context.

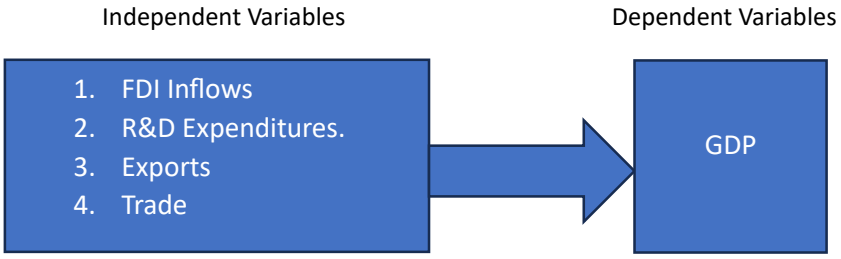
Correspondingly, (Popa, 2020) study correlates macroeconomic indicators with labor productivity growth, accentuating the strategic fusion of factors like investment, export, and research and development to enhance productivity. This underscores the indispensable role of attracting FDI for comprehensive economic development.

The positive impact of Research and Development within Foreign Direct Investment has a ripple effect on exports, enhancing the quality and competitiveness of goods and services. Yasin and (Yasin & Esquivias, 2023) study on Indonesia highlights that FDI spillover effects positively contribute to export activities. To boost export intensity, the study recommends focusing on enhancing human capital and implementing policies that encourage FDI in complementary sectors. This underscores the interconnectedness of FDI, R&D, and economic development, emphasizing the importance of strategic planning and policies to promote economic diversification.

Furthermore, the multiplier effect extends to the broader innovation ecosystem, fostering entrepreneurship, and start-ups leveraging R&D advancements to create new businesses (Sugiharti et al., 2022). This symbiotic relationship aligns with (Flechas et al., 2023) study using Partial Least Squares Structural Equation Modeling demonstrates that collaborative efforts between universities, enterprises, and governments positively influence the startup ecosystem. This interdependence creates an environment conducive to sustained growth on a global scale, highlighting the profound impact of cooperative endeavors in translating research-driven advancements into entrepreneurial activities, ultimately promoting continuous innovation and global growth.

2.3. Theoretical Framework

This section provides a theoretical framework that delineates the influence of Research and Development in Foreign Direct Investment on Economic Growth. The independent variables include FDI Net Inflows (% of GDP), offering insight into the impact of foreign investment on the economy; R&D Expenditure (% of GDP), reflecting the commitment to research and development activities and their influence on technological innovation and knowledge creation; Trade (% of GDP), highlighting the degree of economic openness to international trade; Exports of Goods and Services (% of GDP), signifying the role of exports in economic expansion; and Communications, serving as a technology proxy, encompassing indicators related to communication infrastructure and technology diffusion. The dependent variable, GDP Growth Annual %, represents the annual percentage growth of the Gross Domestic Product, serving as a measure of economic growth. The framework posits that these variables collectively shape Turkey's economic development.



2.4: Research Hypothesis

H1: Foreign Direct Investment (FDI) positively impacts economic growth.
H2: Research and Development (R&D) statistically influence economic growth.
H3: Export has a positive significant impact on economic growth
H4: Trade has a positive significant effect on economic growth.

3. METHODOLOGY

In order to analyze research and development-driven foreign direct investment and its effects on Turkey's economic landscape, we employ a quantitative technique in this study that makes use of a Vector Error Correction Model (VECM) and data ranging from 1973 to 2022. We use secondary data from the International Monetary Fund (IMF) and the World Bank database. Our goals are to determine the relationship between research and development (R&D) and foreign direct investment (FDI) in Turkey by using GDP as a proxy for economic growth for the dependent variables and exports, trade, R&D, and FDI as the independent variables. In order to minimize heteroscedasticity issues, each of these variables is taken at its natural logarithm.

Definition Of Variables

GDP: The gross domestic product (GDP) measures the monetary value of final products and services—i.e., those that the consumer purchases—that are produced in a country during a given time period, such a quarter or two. It includes all production that occurs within the borders of a country. Its focus on the overall quantity of goods and services that the nation generated led to its selection as the independent variable. This variable is utilized by numerous researchers in their investigations, such as (Callen, 2008)

EXPORT: The products and services that a nation produces domestically and sells to companies or clients who live outside are known as exports. As a result, the nation selling its goods and services sees an increase in financial inflow. This variable was also used by (Product & States, 2019) on his studies impact of export and import on economic growth.

FDI: According to the definitions given by the OECD and IMF, the objective of direct investment is for a resident entity of one nation (the direct investor) to purchase a long-term stake in an enterprise that is a resident of another nation (the direct investment enterprise).

The variable was chosen by (Karahan & Çolak, 2024) in his studies on The causality relationship between foreign direct investment and economic growth in RCEP countries.

R&D: Research and development refers to the actions that businesses or countries do to innovate, launch new goods and services, or enhance their current lineup. This is done to boost a company's profitability and economic growth. Similar variable was used by (Analysis, n.d.) in his studies R&D, Innovation, and Economic Growth:

TRADE: We choose to use trade as a macroeconomic variable in order to comprehend the effects of a nation's overall import and export of commodities and services on the performance of foreign direct investment. Countries that are unable to generate commodities and services can obtain them through foreign commerce. Also making use of this variable was (Keho, 2017)

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3.1 Model Specification

The current model was selected because it enables the production and estimation of all parameters without leading to needless data mining. The following model can be used to describe the relationship between economic growth (as measured by GDP growth) and Foreign direct investment, export, Research and Development, and Trade in Turkey in a linear form.

$LnGDPt = \alpha + \beta LnFDIt + \beta LnEXPt\text{-}1 + \beta LnRDt\text{-}2 + \beta lNTRADEt\text{-}3 + \varepsilon t$

The variables are still in their natural logarithm form, but they are no longer defined as they were previously. The error term, denoted as **εt**, is presumed to be regularly, identically, and independently distributed. Here, **εt** stands for the error term; α and β for the slope and coefficient of regression; and GDP t, FDI t-1, EXP t-2, R&D t-3, and TRADE t-4 for the growth in the gross domestic product and the independent variables, respectively. A unit change in the independent variables impacts the dependent variables' Gross Domestic Product.

(GDP), as indicated by the coefficient of regression. The error term, εt, is integrated into the formula to account for other variables that could impact GDP.

4. EMPIRICAL ANALYSIS AND DISCUSSIONS

4.1 Unit Root Test

UNIT ROOT ADF TEST RESULTS

According to the unit root test, which is based on the null hypothesis, the variables tested are non-stationary if there is a unit root test; if the p-value for the test is less than the 5% significance level, we must reject the null hypothesis since it indicates that the variables are stationary.

I. Table :

ADF TEST

VARAIBLE	LEVEL	FIRST DIFFERENCE
LCGDP	0.0000	0.0000
LEXP	0.6023	0.0003
LFDI	0.0081	0.0000
LR&D	0.1745	0.0000
LTRADE	0.2211	0.0001

We use the ADF test to check for the unit root at the level. The results show that GDP and FDI all have a p-value less than 0.05% significance level. Still, Export, R&D, and Trade all have a p-value of more than 0.05% significance level, and these results allow us to reject the null hypothesis as one of our variables of interest did not attain the stationary level. We later continued with the first difference test, in which all my variables indicated a p-value of less than 5%. The results from the first difference suggest that we reject the null hypothesis as the probability values of all the individual variables are less than 5% significance level, meaning they are stationary at the first difference.

4.2: Lag Length Criteria

II. Table.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-127.1744	NA	0.000215	5.746713	5.945479	5.821172
1	-13.07604	198.4319	4.51e-06	1.872871	3.065463*	2.319623
2	27.73191	62.09905	2.36e-06	1.185569	3.371988	2.004615*
3	57.52631	38.86225*	2.13e-06*	0.977117	4.157363	2.168456
4	87.21094	32.26591	2.15e-06	0.773437*	4.947510	2.337070

The five endogenous variables in the VAR system are GDP_L, Exports_L, FDI_L, R&D_L, and Trade_L. Table two reports the outcome of the lag length criteria test, which was conducted using the five-variable VAR system with a maximum lag number of 4. The LR test, the FPE, the AIC, and the SC criterion all selected three lag orders.

4.3: Johansen Cointegration Test

The Johansen and Juselius (1992) LR statistic for cointegration was used to test for the presence of a long-run relationship between the variables after identifying the time series properties of the data. One important technique used in this work to test cointegration is the Johansen cointegration methodology. The Johanson technique can be used to find the number of cointegrated vectors at the 5% significance level for any given number of non-stationary variables of the same order. The findings demonstrate that, for ranks of zero and less than or equal to five, the null hypothesis of no cointegration is rejected. This suggests that over the long run, as demonstrated by the trace test, there are two cointegrations for the trace test and one cointegration for the max eigenvalue test between the variables.

Table 4.3.1: TRACE TEST

III. Table:

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.541974	83.95924	69.81889	0.0025
At most 1 *	0.425958	48.04108	47.85613	0.0480
At most 2	0.315407	22.50867	29.79707	0.2710
At most 3	0.104479	5.077838	15.49471	0.8005
At most 4	3.79E-05	0.001744	3.841465	0.9641

Johansen Cointegration Rank Trace Test

Table 4: Below are the findings from the Johansen cointegration trace test. The results indicate two co-integrating vectors at an alpha 5% significance level. This shows that the null hypothesis of no co-integration is rejected for the rank of zero and less than or equal to five. This is to say that (the existence of two cointegrating vectors indicates that we leave the HO of the no cointegration is rejected). This shows that there is a connection that exists between the two variables over a long period.

Table 4.3.2: MAXIMUM EIGENVALUE TEST

IV. Table.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.541974	35.91816	33.87687	0.0282
At most 1	0.425958	25.53241	27.58434	0.0894
At most 2	0.315407	17.43083	21.13162	0.1526
At most 3	0.104479	5.076094	14.26460	0.7322
At most 4	3.79E-05	0.001744	3.841465	0.9641

Similarly, the Johansen cointegration maximum Eigenvalue test indicates one cointegrating vector at an alpha 5% significance level. Therefore, the null hypothesis of no cointegration is rejected for the rank of zero or less than or equal to five.

4.4: GRANGER CAUSALITY TEST

V. Table.

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 01/24/24 Time: 04:42
Sample: 1973 2022
Included observations: 46

Dependent variable: D(LCGDP)

Excluded	Chi-sq	df	Prob.
D(LEXP)	2.366149	3	0.5000
D(LFDI)	2.460241	3	0.4825
D(LRD)	2.507152	3	0.4740
D(LTRADE)	2.727202	3	0.4356
All	12.60148	12	0.3987

Dependent variable: D(LEXP)

Excluded	Chi-sq	df	Prob.
D(LCGDP)	8.870054	3	0.0311
D(LFDI)	5.986822	3	0.1123
D(LRD)	15.89898	3	0.0012
D(LTRADE)	17.84667	3	0.0005
All	80.20510	12	0.0000

Dependent variable: D(LFDI)

Excluded	Chi-sq	df	Prob.
D(LCGDP)	3.597618	3	0.3083
D(LEXP)	13.61311	3	0.0035
D(LRD)	2.211235	3	0.5297
D(LTRADE)	16.10583	3	0.0011
All	38.48494	12	0.0001

Dependent variable: D(LRD)

Excluded	Chi-sq	df	Prob.
D(LCGDP)	0.028986	3	0.9987
D(LEXP)	2.951369	3	0.3992
D(LFDI)	1.404019	3	0.7046
D(LTRADE)	3.358695	3	0.3396
All	5.916652	12	0.9202

Dependent variable: D(LTRADE)

Excluded	Chi-sq	df	Prob.
D(LCGDP)	11.33324	3	0.0101
D(LEXP)	17.30200	3	0.0006
D(LFDI)	11.00008	3	0.0117
D(LRD)	5.390477	3	0.1453
All	45.49340	12	0.0000

Table 3 shows a detailed analytical report of the causality relationship between these variables. In this report, we can reject the hypothesis and accept the alternative hypothesis when the p-values are less than the alpha 5% significance level. As we can see from Table 3, “Export, FDI, R&D, and Trade do not cause GDP.” Therefore, the null hypothesis could not be rejected since their p-value is more than 0.05 significance level. Thus, this situation suggests no significant conclusion that all the independent variables influence GDP amount. Similarly, it can also be understood that the null hypothesis of “GDP, R&D, and Trade does not cause export”; therefore, the null hypothesis could be rejected because their p-value is less than 0.05 significance level. However, “FDI does not cause export” and could not be dismissed because its p-value is more than 0.05 significance level. This shows a significant conclusion that GDP, R&D, and Trade influence exports. Additionally, it was also determined that “GDP and R&D do not cause FDI” as a result of their p-value greater than 0.05 significance level; thus, the null hypothesis could not be rejected, while the probability values of the null hypothesis of “exports and trade does not cause FDI” as their p-value are less than 0.05 we therefore reject the null hypothesis. Furthermore, the results also show that the probability value of the null hypothesis “GDP, Export, FDI and Trade” does not cause R&D” therefore, the hypothesis could not be rejected as their p-values are more than 0.05 significance level. Finally, it was also suggested that the p-values of the hypothesis, “GDP, FDI, and export do not cause trade,” due to their p-values being less than 0.05, and the Ho would be rejected. However, the p-value of R&D is higher than the 0.05 significance level’; therefore, the null hypothesis could not be dismissed.

4.5: Vector Error Correction Model (VECM)

VI. Table.

Error Correction:	D(LCGDP)	D(LEXP)	D(LFDI)	D(LRD)	D(LTRADE)
CointEq1	-1.577185 (0.37487) [-4.20726]	0.008007 (0.02045) [0.39144]	0.163751 (0.07355) [2.22653]	0.025542 (0.02894) [0.88246]	-0.018418 (0.02090) [-0.88138]
D(LCGDP(-1))	0.384738 (0.32042) [1.20074]	0.017745 (0.01748) [1.01499]	-0.090922 (0.06286) [-1.44638]	-0.003563 (0.02474) [-0.14401]	0.041459 (0.01786) [2.32116]
D(LCGDP(-2))	0.201149 (0.26728) [0.75256]	0.003813 (0.01458) [0.26142]	-0.058358 (0.05244) [-1.11290]	-0.003315 (0.02064) [-0.16065]	0.016879 (0.01490) [1.13285]
D(LCGDP(-3))	0.336427 (0.18501) [1.81841]	-0.015001 (0.01009) [-1.48598]	-0.002155 (0.03630) [-0.05936]	-0.001201 (0.01428) [-0.08410]	-0.003973 (0.01031) [-0.38521]
D(LEXP(-1))	-1.898987 (6.10204) [-0.31121]	0.579148 (0.33295) [1.73943]	-0.891232 (1.19715) [-0.74446]	0.603473 (0.47115) [1.28086]	1.131732 (0.34015) [3.32717]
D(LEXP(-2))	-7.003340 (4.81554) [-1.45432]	0.993113 (0.26276) [3.77960]	0.302827 (0.94475) [0.32054]	0.507505 (0.37181) [1.36495]	0.978319 (0.26843) [3.64454]
D(LEXP(-3))	-0.707191 (3.65011) [-0.19374]	0.327409 (0.19917) [1.64391]	2.315789 (0.71611) [3.23386]	0.358176 (0.28183) [1.27090]	0.242580 (0.20347) [1.19222]
D(LFDI(-1))	0.942220 (0.60572) [1.55553]	-0.010867 (0.03305) [-0.32880]	-0.428155 (0.11884) [-3.60292]	-0.019331 (0.04677) [-0.41332]	0.009000 (0.03377) [0.26653]
D(LFDI(-2))	0.120361 (0.57603) [0.20895]	-0.005757 (0.03143) [-0.18316]	-0.185885 (0.11301) [-1.64486]	-0.002003 (0.04448) [-0.04505]	0.025738 (0.03211) [0.80157]
D(LFDI(-3))	0.234278 (0.55584) [0.42148]	0.067397 (0.03033) [2.22218]	-0.257344 (0.10905) [-2.35988]	0.042543 (0.04292) [0.99127]	0.102135 (0.03098) [3.29633]
D(LRD(-1))	-2.908024 (2.48032) [-1.17244]	0.134711 (0.13534) [0.99538]	0.245311 (0.48661) [0.50412]	-0.403140 (0.19151) [-2.10508]	0.095187 (0.13826) [0.68845]
D(LRD(-2))	-2.987925 (2.73350) [-1.09308]	-0.446390 (0.14915) [-2.99286]	0.062606 (0.53628) [0.11674]	-0.278054 (0.21106) [-1.31744]	-0.205758 (0.15237) [-1.35035]
D(LRD(-3))	1.074974 (2.95689) [0.36355]	-0.092133 (0.16134) [-0.57105]	-0.698154 (0.58011) [-1.20349]	0.061745 (0.22830) [0.27045]	0.151401 (0.16483) [0.91855]
D(LTRADE(-1))	5.427384 (5.71707) [0.94933]	-0.141259 (0.31195) [-0.45283]	1.399938 (1.12162) [1.24814]	-0.514955 (0.44142) [-1.16658]	-0.871178 (0.31869) [-2.73363]
D(LTRADE(-2))	5.998660 (6.01195) [0.99779]	-1.042954 (0.32804) [-3.17937]	-0.202960 (1.17947) [-0.17208]	-0.810653 (0.46419) [-1.74638]	-1.401913 (0.33513) [-4.18324]
D(LTRADE(-3))	8.453143 (5.26071) [1.60684]	-0.833032 (0.28705) [-2.90208]	-3.066059 (1.03209) [-2.97074]	-0.515172 (0.40619) [-1.26832]	-0.593026 (0.29325) [-2.02226]
C	-0.174885 (0.35626) [-0.49090]	0.039725 (0.01944) [2.04361]	0.142223 (0.06989) [2.03487]	0.042670 (0.02751) [1.55125]	0.020422 (0.01986) [1.02835]

This table shows how much the previous values have affected the current variables under study is shown by the coefficient of the Vector Error Correction Term. Past equilibrium errors are crucial in predicting the recent results, as demonstrated by a substantial coefficient. The pace at which the system adjusts to long-run equilibrium is correlated with the VECM results. Each coefficient of the difference terms reflects the short-run dynamics.

4.6: Impulse Response

VII. Table.

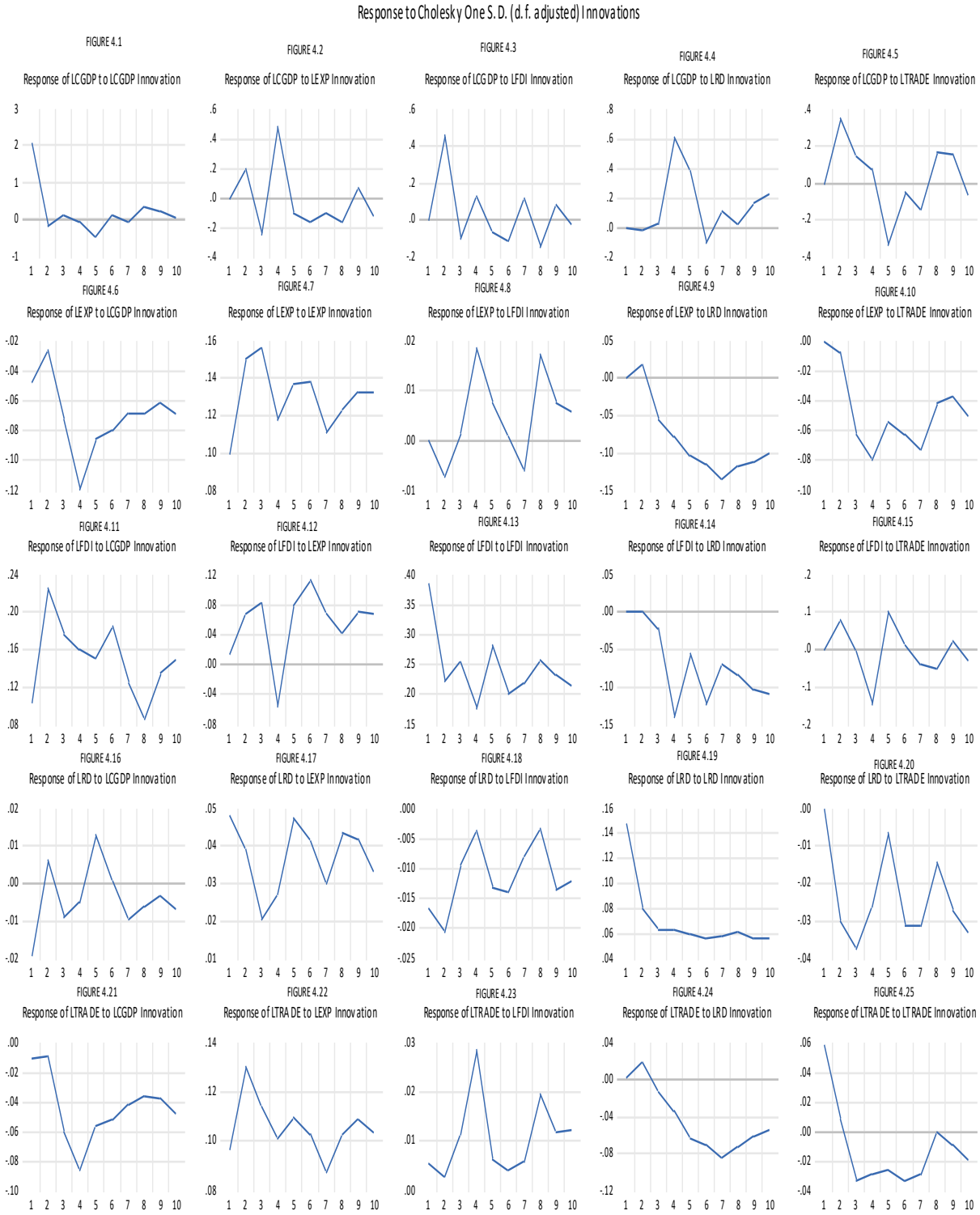

Figure 4.6 exhibits the Cholesky asymptotic impulse response function. It includes 25

Small figures are denoted Figure 4.1, Figure 4.2, through Figure 4.25. Each small figure shows the changes in the response of each target variable (LGDP_L, EXPORT_L, FDI_L, TRADE_ L, R&D) to a one-standard-deviation shock on itself and other variables. Figure 4.1 shows that GDP shock has a short-run positive impact on GDP in the first year. After that, the shock decreases drastically till the seventh year and shows an insignificant effect on itself. Figure 4.2 shows that the shock of exports on GDP has a short-run impact in the beginning, later it decreased till the third year, showing a negative impact. Later in the fourth year, the shock returned to its pre-shock level, indicating a positive effect till the fourth year, and afterward, the shock decreased, showing a negative impact

for the rest of the period. Figure 4.3 shows that FDI has a short-run effect on GDP in the beginning. The shock reduces through fluctuation leading to a negative impact throughout the rest of the period. Figure 4.4 shows that the shock of R&D at the beginning of the year was stagnant. Afterward, the shock kept fluctuating throughout the rest of the periods showing a positive impact in the tenth-year. Figure 4.5 shows that the shock of trade on GDP has a short-run positive effect on GDP at the beginning. After the third period, the shock decreased drastically, showing an insignificant impact on GDP till the seventh year. The shock returns to its pre-shock level after the seventh year and falls at the end of the period.

Figure 4.6 shows that the shock of GDP on exports has no significant impact. Figure 4.7 shows that the shock of export on export has a long-term positive impact on itself. After that, the shock kept fluctuating during the rest of the years, showing a consistent effect on exports. Figure 4.8 shows that FDI shock has a short-run negative impact on exports. After that, the shock increase indicating a long-run positive impact till the sixth year. After the sixth- year FDI shock keep fluctuating throughout the rest of the years and indicating a long-run positive impact over time. Figure 4.9 shows that the shock of R&D on exports initially has a short-run effect on exports. The shock later decreased drastically, negatively impacting exports in the rest of the years. Figure 4.10 shows that the trade shock on exports has a negative significant impact. Figure 4.11 shows that the shock of GDP on FDI has a short-run positive impact on GDP in the beginning. After that, the shock kept fluctuating, showing a significant effect over the years. Figure 4.12 suggests that, in the short run, export shock has a positive significance on FDI from the beginning till the third period. After that, the shock decreases in the fourth period, showing a negative impact. Later, the shock returns to its pre-shock level, showing a significant impact over the years. Figure 4.13 suggests that the shock of FDI on FDI has a short-run positive impact on itself. This shock later decreases throughout the years, indicating positive significance. Figure 5.14 suggests that the shock of R&D on FDI has a negative significant effect. Figure 4.15 indicates that the impact of trade on FDI shows a short-run positive impact in the beginning. The shock decreases throughout the years, leading to a negative impact.

Figure 4.16 shows that GDP shock has a short-run negative impact on R&D from the beginning till the fourth year. The shock later increased slightly in the fourth year, showing a positive impact. After that, the shock subsequently decreases, leading to negative significance through the rest of the period. Figure 4.17 suggests that the shock of exports has a short-run significance on R&D; after that, the shock keeps fluctuating throughout the years, showing a positive impact on R&D. Figure 4.18 indicates that FDI shock on GDP has a negative insignificant. Figure 4.19 shows that R&D shock has a short-run effect on R&D at the beginning of the year. Afterward, the shock decreases throughout the period, significantly affecting itself. Figure 4.20 suggests that the trade shock on R&D shows a negative insignificant.

Figure 4.21 shows that the shock of GDP on trade has a significant negative impact. Figure 4.22 suggests that the export shock has a short-run positive impact till the third year. This shock later decreases through fluctuation within different years, showing positive significance. Figure 4.23 suggests that, in the long run, FDI shocks positively impact R&D till the fifth year. After that, the shock later decreases throughout the rest of the years, showing a positive impact. Figure 4.24 shows that the shock of R&D has a negative significant impact on trade. Figure 4.25 shows that Trade shock has a short-term positive impact from the beginning until the second year. After that, the shock decreases drastically, leading to a significant adverse effect on itself throughout the rest of the years.

4.7: Variance Decomposition

VIII. Table

Variance Decomposition of LCGDP:

Period	S.E.	LCGDP	LEXP	LFDI	LRD	LTRADE
1	2.035304	100.0000	0.000000	0.000000	0.000000	0.000000
2	2.129000	91.86127	0.826806	4.611028	0.016421	2.684477
3	2.153090	90.03753	2.136411	4.755035	0.022708	3.048312
4	2.293027	79.43889	6.364394	4.484826	6.906927	2.804968
5	2.401734	76.45545	5.989953	4.183768	8.780687	4.590143
6	2.415618	75.81084	6.422685	4.339238	8.852325	4.574917
7	2.427538	75.08493	6.558839	4.517566	8.960739	4.877927
8	2.463579	74.58002	6.802703	4.730819	8.709522	5.176938
9	2.488659	74.07161	6.727210	4.748245	8.972170	5.480770
10	2.504202	73.19390	6.965171	4.695213	9.646612	5.499103

Variance Decomposition of LEXP:

Period	S.E.	LCGDP	LEXP	LFDI	LRD	LTRADE
1	0.110945	18.83392	81.16608	0.000000	0.000000	0.000000
2	0.190024	8.330518	90.49031	0.147174	0.839740	0.192258
3	0.269386	11.55569	78.43666	0.076517	4.515206	5.415931
4	0.337128	19.83552	62.30513	0.351568	8.418692	9.089092
5	0.392033	19.47802	58.26263	0.297517	13.33809	8.623733
6	0.442938	18.52402	55.29873	0.233517	17.22581	8.717922
7	0.485991	17.35877	51.17783	0.209317	21.82241	9.431678
8	0.521286	16.79270	50.05097	0.292897	24.04753	8.815904
9	0.554080	16.12058	50.05139	0.277613	25.29046	8.259953
10	0.584732	15.86628	50.08768	0.258829	25.64676	8.140450

Variance Decomposition of LFDI:

Period	S.E.	LCGDP	LEXP	LFDI	LRD	LTRADE
1	0.398930	6.890497	0.121482	92.98802	0.000000	0.000000
2	0.519681	23.00322	1.765960	73.00852	0.000299	2.222006
3	0.609832	24.91289	3.033750	70.29341	0.132221	1.627726
4	0.688250	25.00250	3.014862	61.76680	4.305710	5.910129
5	0.772402	23.64113	3.447427	62.46336	3.934173	6.513906
6	0.836311	25.01891	4.757899	59.15353	5.498986	5.570669
7	0.879768	24.60954	4.903364	59.69028	5.587079	5.209737
8	0.926331	23.04884	4.623334	61.47893	5.848236	5.000663
9	0.973359	22.82468	4.702906	61.45139	6.435349	4.585675
10	1.016694	23.04898	4.773372	60.77769	7.071545	4.328417

Variance Decomposition of LRD:

Period	S.E.	LCGDP	LEXP	LFDI	LRD	LTRADE
1	0.156997	1.519394	9.461881	1.143454	87.87527	0.000000
2	0.184289	1.223113	11.41352	2.069033	82.58930	2.705028
3	0.199538	1.241670	10.75636	1.980273	80.20667	5.815025
4	0.212475	1.152325	11.12143	1.774965	79.31780	6.633479
5	0.226309	1.353794	14.16981	1.906680	76.63852	5.931198
6	0.239110	1.212921	15.69853	2.037658	74.04939	7.001499
7	0.249985	1.256391	15.81085	1.961178	73.03068	7.940898
8	0.261410	1.204240	17.24442	1.810616	72.18627	7.554451
9	0.272353	1.126928	18.24672	1.922104	70.73747	7.966781
10	0.282253	1.102001	18.32991	1.970223	69.76288	8.834984

Variance Decomposition of LTRADE:

Period	S.E.	LCGDP	LEXP	LFDI	LRD	LTRADE
1	0.113341	0.804269	72.84595	0.228356	0.083772	26.03765
2	0.174060	0.621923	86.79759	0.121768	1.214099	11.24461
3	0.219861	7.870424	81.16840	0.337269	1.211234	9.412669
4	0.262470	16.28602	71.79269	1.409514	2.661303	7.850472
5	0.298366	16.25729	69.03068	1.135580	6.747320	6.829127
6	0.329315	15.81515	66.40037	0.946076	10.19823	6.640175
7	0.355024	14.98667	63.19504	0.841499	14.58892	6.387867
8	0.378903	14.09542	62.86844	1.002248	16.42575	5.608143
9	0.401244	13.46893	63.40279	0.981650	17.09125	5.055379
10	0.421384	13.53285	63.53172	0.975964	17.16445	4.795022

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LCGDP LEXP LFDI LRD LTRADE

The table shows the results from the variance decomposition of each endogenous variable. There are four sections to this table. The variance decomposition of (LCGDP) is reported in the first section. The variance decomposition of commerce (LTrade), research and development (LR&D), foreign direct investment (LFDI), and exports (LExp) is shown in the remaining sections. Furthermore, Examining Table eight, the GDP's volatility can be mostly attributed to shocks. In the first year, GDP shock accounts for 100% of the variance; after time, its fraction diminishes reaching 73.1% in the tenth year. The shock of exports accounts for 81% in the first year. Its proportion keeps falling after the second year till the tenth year, accounting for 50%. Afterward, the shock fluctuates through the rest of the years, accounting for 90% of the greatest shocks. Similarly, FDI shocks account for 92.9 % in the first year. After that, its proportion in variance decreased till the fourth year, accounting for 61.7%. The shock returns to its pre-shock level, accounting for 62.4% in the fifth year, which later fluctuates throughout the rest of the years till the tenth year, accounting for 60.7%. Additionally, the fluctuation of R&D is also explained by its shock. R&D shock accounts for 87.8% in the first year and decreases to 69.7% in the tenth year. Finally, the fluctuation of trade is explained mainly by its shock. Trade shocks account for 26% in the first year. Its proportion of variance falls over time reaches 4% in the tenth period.

In Summary, Export and R&D shock are the most essential sources of shock to GDP and trade. Export and R&D shock, assumed to account for the whole variance in their first years, continue to dominate throughout the rest of the year. Their proportion falls over time but accounts for 50% and 69% in their tenth year, respectively. In the long run, exports and R&D are the most crucial source of GDP variability. The shock of GDP, R&D, and exports are important sources of variability for themselves initially, but this self-effect decreases for all variables except R&D and export.

5. DISCUSSION

These sections highlight the empirical findings from my regression and how is relates or disagree with previous research. However, the findings of my work are backed by previous studies which make this findings important to help policy makers make inform decisions.

- The unit root test results at the level show that GDP and FDI have a p-value of less than 0.05% significance level, but Export, R&D, and Trade all have a p-value of more than 0.05% significance level. These results allow us to reject the null hypothesis as one of our variables of interest did not attain the stationary level. Similarly, the first difference results indicate a p-value less than alpha 5%, which allows us to reject the null hypothesis as the probability values of all the individual variables are less than 5% significance level, which indicates they are stationary.
- The cointegration results confirm that three cointegration results exist between the variables, indicating a long-run equilibrium relationship between the variables as indicated by the Johansen cointegration test results.
- The Granger causality evidence shows that trade and export are the leading causes of FDI and R&D; this means that the OIC member states, which have higher export and trade amounts, are given more FDI and R&D investment to improve their economic growth. This finding is similar to (Sandu & Ciocanel, 2014) research findings which states that the majority of R&D expenditure volume and the number of high-tech exports is positively correlated, however the exact relationship varies throughout nations, according to research data. Furthermore, private research and development spending has a greater impact on high-tech exports than does public research and development spending. Achieving the goal of 3% GDP for EU R&D expenditure, and specifically 2% GDP for EU private R&D expenditure, could greatly increase exports and competitiveness in line with existing European and national policies aimed at intensifying R&D financing.
- The error correction results indicate that the Error-Correction Term is statistically significant and has a negative sign, showing no problem in the long-run equilibrium relations between the independent and dependent variables. Their relative price of 1.57725 (-4.20629) indicates a pace of convergence to the equilibrium point each period deemed satisfactory. Additionally, the value of R-square for variable GDP is 0.69, means that this model reveals 69 percent of variability in the variables used in this model and explained by the VECM model. The F-statistics with a value of 4.052825 >1 percent shows that the overall model is statistically significant
- The results indicate that R&D has contributed to Turkey's economic growth according to the impulse response shock of R&D on economic growth. Similarly, the results on FDI show that it has not contributed enough to economic growth in Turkey from 1973 to 2022. Therefore, it is vital for the government of Turkey to make innovative policies that will attract foreign investment in such a way that it will be more growth driven than growth retarding. This result is similar to findings of (Emmanuel, n.d.) who argued that, “GDP, inflation and Exchange Rate are affected to the extent of 46.5% by FDI. FDI does not make the GDP to grow, increases inflation and has negative effect on exchange rate”.

6. CONCLUSION

This chapter applies the five- variables VECM model, which is constructed from five endogenous variables- the variables were taken in their logarithm form (LGDP, LFDI, LEXPORT, LR&D, and LTRADE) to investigate and examine the relationship between FDI and R&D on the economic growth of Turkey. The paper examines Research and Development-Driven Foreign Direct Investment and its Ramifications on Turkey's Economic Landscape using VECM Approach and as well as using annual data from 1973 to 2022. The unit root test of the data was examined using the Augmented Dickey-Fuller test (ADF), After which the cointegration and Granger causality test was also conducted. The error correction model was also estimated to examine the short-term dynamics. Similarly, the impulse response and variance decomposition were also estimated to give an accurate interpretation of the paper. Finally, while FDI has enormous potential for economic development, there are other solutions for some development issues, because of its effects on economic growth and productivity, FDI plays a significant role in this process by providing the funds and resources required to support government-led initiatives that foster social safety nets and offer essential social services. Additionally, for FDI to pour in, the Turkish government must establish the necessary conditions to improve their economic growth. Furthermore, the host economy can potentially experience productivity growth when it has a liberal and competitive investment climate. Still, improvements will only happen once domestic actors can react to the new incentives. Therefore, enhancing infrastructure and education would be crucial policy measures to boost domestic absorption of FDI benefits. For FDI to significantly contribute to economic growth, Turkey would be better served by enhancing its human resources, infrastructure, and local entrepreneurship while establishing a stable macroeconomic framework and favorable investment conditions to support the development process.

LIMITATITION of the STUDY

These studies face lot of challenges in terms of data sample size as the initial sample size was from 1970-2023, but unfortunately some of the data were missing for the years. Additionally, the research also focusses on annual data which is not precise to give the real and quick impact of FDI ramification on the economic growth of turkey. In this view, future research can focus on quarterly data, more sample size, and the import variable can be look added to give more insight of the future studies.

REFERENCES

1) Analysis, A. E. (n.d.). IMF Working Paper.
2) Callen, T. (2008). Gross Domestic. December.
3) Crespo, N., & Fontoura, M. P. (2007). Determinant Factors of FDI Spillovers - What Do We Really Know? World Development, 35(3), 410–425. https://doi.org/10.1016/j.worlddev.2006.04.001
4) Emmanuel, U. C. (n.d.). EFFECTS OF FOREIGN DIRECT INVESTMENT (FDI) ON ECONOMIC GROWTH IN NIGERIA *Umeora Chinweobo Emmanuel. 1–14.
5) Flechas, X. A., Kazunari Takahashi, C., & Bastos de Figueiredo, J. C. (2023). The triple helix and the quality of the startup ecosystem: a global view. Revista de Gestao, 30(3), 238–252. https://doi.org/10.1108/REGE-04-2021-0077
6) Guloglu, B., & Tekin, R. B. (2012). A Panel Causality Analysis of the Relationship among Research and Development, Innovation, and Economic Growth in High-Income OECD Countries. Eurasian Economic Review, 2(1), 32–47. https://doi.org/10.14208/BF03353831
7) Iyoha, M., & Okim, A. (2017). The Impact of Trade on Economic Growth in ECOWAS Countries: Evidence from Panel Data. CBN Journal of Applied Statistics, 8(1), 23–48.
8) Karahan, Ö., & Çolak, O. (2024). The causality relationship between foreign direct investment and economic growth in RCEP countries. Journal of Economic and Administrative Sciences, 40(1), 95–110. https://doi.org/10.1108/JEAS-04-2022-0112
9) Keho, Y. (2017). The impact of trade openness on economic growth: The case of Cote d'Ivoire. Cogent Economics and Finance, 5(1). https://doi.org/10.1080/23322039.2017.1332820
10) Lucas, R. E. (1988). World Devziopment Report. Journal of Monetary Economics, 22(February), 3–42. http://linkinghub.elsevier.com/retrieve/pii/0304393288901687
11) Mtaturu, J. (2016). the Relationship Between Export and Economic Growth in Tanzania: Granger Causality Approach (1976 – 2013). Business Education Journal, 2(1), 1–17. https://doi.org/10.54156/cbe.bej.2.1.88
12) Popa, M. (2020). the Correlation Between Some Macroeconomic Indicators (Innovation, R&D, Fdi) and Their Impact on the Increase of Labor Productivity. Eurasian Journal of Social Sciences, 8(4), 175–184. https://doi.org/10.15604/ejss.2020.08.04.003
13) Product, G. D., & States, U. (2019). Impact of Export and Import on Economic Growth : Time Series Evidence from India. 19, 29–40.
14) Sandu, S., & Ciocanel, B. (2014). Impact of R & D and Innovation on high - tech export. Procedia Economics and Finance, 15(14), 80–90. https://doi.org/10.1016/S2212-5671(14)00450-X
15) Sugiharti, L., Yasin, M. Z., Purwono, R., Esquivias, M. A., & Pane, D. (2022). The FDI Spillover Effect on the Efficiency and Productivity of Manufacturing Firms: Its Implication on Open Innovation. Journal of Open Innovation: Technology, Market, and Complexity, 8(2), 99. https://doi.org/10.3390/joitmc8020099
16) Usman, M., . H. W. K., & . H. K. (2012). Impact of Exports on Economic Growth- A Case of Luxemburg. Information Management and Business Review, 4(1), 1–7. https://doi.org/10.22610/imbr.v4i1.957
17) Yasin, M. Z., & Esquivias, M. A. (2023). SpilloveEsquivias' (2023) effects of foreign direct investment on manufacturing exports and imports in Indonesia. Studies in Economics and Finance, 40(4), 625–646. https://doi.org/10.1108/SEF-12-2022-0551