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The relationship between the GDP, FDI, and non-oil exports in the Saudi economy - 1970-2019: Evidence from (VECM) and (ARDL) assessment - according to Vision 2030

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Abstract. This study examines the long-term and short-term balance relationship of GDP, Foreign Direct Investment to the performance of nonoil exports in KSA within the framework of the export-led growth (ELG) hypothesis: Evidence from ARDL, VECM and a smaller evaluation according to Vision 2030. We performed an analysis for the period from 1970 to 2019 by an autoregressive distributed lag (ARDL) model and checked the robustness of the results in the vector error correction (VECM) model. The co-integration and Toda - Yamamoto causality analysis are conducted by using two techniques of vector error correction model (VECM) and autoregressive distributed lag (ARDL). The main findings are: Foreign direct investment can increase GDP growth rates by increasing non-oil exports in the Saudi economy according to the results of the Toda - Yamamoto Causality Test; and the GDP in the Saudi economy are affected by FDI and the rates of non-oil exports, in the long and short term, and the reason is the strength of the reserves of the Saudi economy. The contribution of this research is that the outcomes found by means of econometric models can be used for predicting and measuring GDP in upcoming years, can get a guideline from this research To the economic policy makers in Saudi Arabia. Also, the dynamic interaction among FDI, non-oil exports, and economic growth is investigated using the ARDL. The ARDL co-integration results showed that GDP, FDI and non-oil exports are co-integrated, indicating the presence of a long-run equilibrium relationship between them. Besides, the results for the relationship between GDP, FDI and Non-Oil Exports are interesting and indicate that there is no significant from variables and vice-versa using Toda-Yamamoto causality.

Keywords. GDP, FDI, Non-oil exports, Stationary, Toda-Yamamoto Test, VECM, ARDL.

JEL. D42, D43, H21, L12, L13.

1. Introduction

In view of the complex socio-economic and environmental factors Since the announcement of Saudi's Vision2030 in April 2016, the Kingdom of Saudi Arabia has witnessed an economic, social and structural transformation as reforms have been implemented towards achieving the Vision's goals. Vision 2030 is supported by 13 approved programs. These programs aim to develop promising economic sectors and increase the productivity of existing pivotal sectors by raising government efficiency

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and stimulating the prosperity of communities. Vision 2030 aims to achieve comprehensive and diversified economic development, especially in the non-oil sector, to achieve economic growth and fiscal sustainability. Vision 2030 will increase job opportunities and female's participation in the labor market, improving the living standards of citizens (Ministry of Finance, KSA 2019, p.13).

Every step made towards production base diversification can be considered a real achievement that we should build on continuously, especially in view of global competition. Every achievement in this area, regardless of how modest it is, also represents a direct safeguard for the future of the Saudi economy in general and the economic potentials that are inherent in this economy and working to diversify it.

The Kingdom's prevailing growth model depends mainly on oil revenues that are redistributed in the economy via government spending on goods, services and employee salaries. Part of this spending relates to citizens' wages and payroll in the public sector and is classified as a consumption expenditure, while another part of it relates to capital spending on development projects, infrastructure and social services. This kind of spending goes to the payment of private sector contracts and profits. After four decades of oil exports, this sector's activity is still concentrated in three main areas: construction, services, and the importation and marketing of foreign products under Commercial Agency Law (Khalid, 2015).

In applied econometrics, co-integration techniques and (ADRL) have become the solution to determining the long run relationship between series that are non-stationary, as well as parameterizing them to the Vector Error Correction Model (VECM) . With this background, the objective of this paper is to examine and measuring the short and long-term equilibrium relationship between GDP, FDI and non-oil exports in the Saudi economy through standard modeling (ARDL), (VECM) and causal for Toda & Yamamoto (1995).

The motivation of this study is to address the following inherent problems observed in the literature. First, although the relationship between GDP, FDI and non-oil exports potentially relates to the incidence of economic growth in a particular economy, the trivariate linkage of GDP, FDI and non-oil exports has not been deliberated yet, especially in the framework of co-integration and Toda & Yamamoto (1995) causality, and VECM, ARDL. Moreover, no study linking the role of FDI in the non-oil export – growth relationship in KSA could be cited from available related literature.

2. Theories of growth and foreign direct investment

According to the endogenous growth theory, the main determinants of economic growth include factors such as economies of scale, increasing returns or induced technological changes in the production process. Romer (1990) and Grossman & Helpman (1991) developed a growth model

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explaining the relationship between FDI and economic growth within the endogenous growth theory. In this model, technological advancement is assumed to be the main driving force of economic growth. The creation of technological knowledge, the transfer of this knowledge and innovation are major engines for growth in these theories. New growth theories finds a bidirectional causality between FDI and growth. Factors that could explain this are as follows: the incorporation of new inputs and foreign technologies in the production function of host country, the increase in host country's existing knowledge through training and development (Borensztein *et al.*, 1998 and De Mello, 1999). Nonetheless, Dowling & Hiemenz (1982) contends that inflow of FDI is stimulated when there is rapid economic growth in the host country. This rapid growth creates an enabling environment and a self-assurance to foreign investors to invest in the host country. Additionally, high levels of capital requirements created as a result of sustainable growth coupled with the host country's need for FDI gives birth to a macroeconomic climate that attracts foreign investors. Hence, foreign direct investment and economic growth has a positive and bidirectional causality relationship.

Several studies have been conducted to measure the causal relationship between GDP, FDI in KSA (e.g. Mohammed, & Tarek 2010, Mounir, & Atef 2018, Khalid, 2013). However, most studies do not use the method of combining tests (ARDL, VECM and Toda-Yamamoto) to measure the causal relationships relationship between GDP, FDI in KSA.

3. Data, model and methods

3.1. Data and empirical modeling

Data were collected the annual data for gross domestic product (GDP), FDI and non-oil exports from the International Monetary Fund. This study covers the annual sample period from 1970 to 2019. The descriptive statistics show that the standard deviations differ among variables. In addition, at the 5% significance level, we find that all variables are normally distributed (Jarque-Bera, Skewness and Kurtosis statistics) See Table 1.

Table 1. Descriptive statistics

Statistics	GDP	FDI	NOE
Mean	6248396260.924869	262681065971.759	120124058821.1863
Median	874450102.521353	155950708152.6145	62431688637.29755
Maximum	39455863929.3334	766350347333.333	399419733333.3329
Minimum	-3732394367.24856	5377333333.33333	2731777777.77778
Std. Deviation	11082189552.44239	242696763626.1531	116249445647.022
Skewness	1.754655550165247	1.0329836795287	1.100208075358777
Kurtosis	5.039691293436434	2.562814741363974	2.883656753798241
JarqueBera	34.32417702379836	9.290316831373444	10.11534789015713

3.2. Methodology

As In time series econometrics, the starting point is to study the time series properties of the variables under consideration to avoid any spurious relationships between them. If the time series properties of the variables are

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satisfied, then possible long-term relationships or co-integration are likely to exist, The analytical procedure adopted in this study include: the specification of the empirical models, the concept of Toda-Yamamoto causality within a ARDL framework, Vector Error-Correction Modeling (VECM). The baseline empirical model is specified to capture the hypothesized relationship among the core variables namely GDP, FDI and non-oil export. In doing this, the endogenous growth theory is a useful guide. This theory emphasizes the role of exports in determining long-run growth via a higher rate of technological innovation and dynamic learning from abroad (Romer, 1986; Lucas, 1988).

Figure 1 shows that Saudi GDP is increasing during the study period because the increase in the rates of FDI, non-oil exports and other variables, and both foreign direct investment and Non-Oil Exports increased during the study period. It was found that during the period 1990 and 2019 the increase and change was A quick and simple. The researcher finds that the change is consistent for all variables during this period.

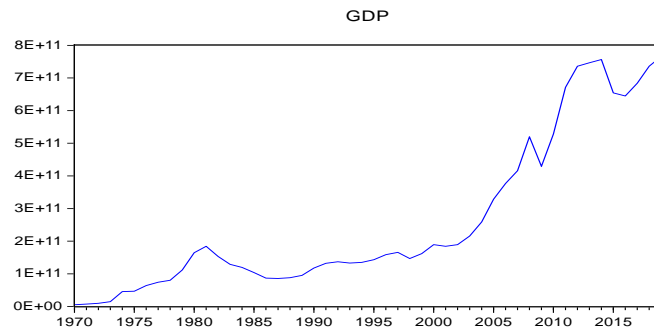


Figure 1. GDP

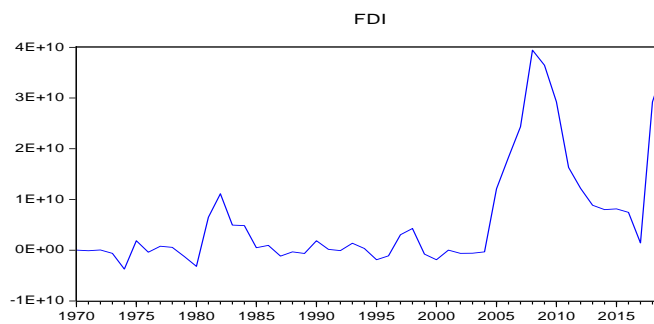


Figure 2. FDI

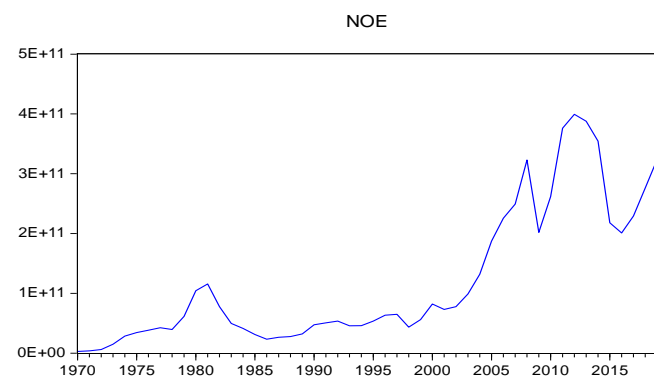


Figure 3. NOE

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3.2.1. Autoregressive distributed lag models (ARDL)

The study draws on the ARDL approach that is proposed by Pesaran et al and subsequently it was modified by Pesaran, Shin and Smith by introducing the bounds testing approaches. We select this technique for two main reasons: First, it is effective in executing the short- and long-term relationships between the different variables that do not have the same order of integration - provided that such variables are stationary in level; I(0), and/or they are stationary in the first difference; I(1). Second, the ARDL approach can remove the problems associated with omitted variables and auto correlation. The model used for the application of the ARDL approach:

$$\Delta GDP_t = \alpha + \sum \beta_i \Delta GDP_{t-1} + \sum \lambda_i \Delta FDI_{t-1} + \phi GDP_{t-1} + \delta NOE_{t-1} + \eta_t$$

GDP= Gross domestic product

FDI= Foreign Direct Investment

NOE= Non-oil exports

($\alpha, \beta, \lambda, \phi, \delta$)= Coefficients of variables

Δ = The first difference for the variables

η = Random error

Although ARDL co-integration technique does not require pre-testing for unit roots, to avoid ARDL model crash in the presence of integrated stochastic trend of I(2), we are of the view the unit root test should be carried out to know the number of unit roots in the series under consideration. This is presented in the next section.

3.2.2. Vector error correction models (VECM)

The VECM approach provides a systematic way to treat non-stationary variables in a simultaneous equation system, thus addressing the issues of simultaneity and non-stationarity. A brief discussion of these issues is followed by a description of the general form of the VECM, and included variables GDP, FDI and Non-Oil Exports of the Saudi economy during the period which is 1970-2019. Causality inferences in the multi-variate framework are made by estimating the parameters of the following VECM equations.

$$\left[\Delta GDP = \alpha + \sum_{i=1}^m \beta_i \Delta GDP_{t-i} + \sum_{k=1}^0 \delta_k \Delta FDI_{t-k} + \sum_{l=1}^p \zeta_l \Delta Non - OilE_{t-l} + \theta Z_{t-1} + \varepsilon \right]$$

where (GDP) and (FDI) denote GDP and FDI respectively, (Non-OilE) is the Non-Oil Exports, and z_{t-1} is the error-correction term which is the lagged residual series of the cointegrating vector. The error-correction term measures the deviations of the series from the long run equilibrium relation.

3.2.3. Toda-Yamamoto (1995) causality

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The Toda & Yamamoto (1995) method of Granger causality test is relatively more efficient in small sample data sizes and is particularly appropriate for time series for which the order of integration is not known or may not be necessarily the same, or the order of integration is more than two. Another advantage of this procedure is that it does not require the pretesting of the time series for cointegration properties so long as the order of integration of the process does not exceed the true lag length of the model. Toda & Yamamoto (1995) methodology of Granger causality test by directly performing the test on the coefficients of the levels VAR, minimises the risk associated with possibly wrongly identifying the orders of integration of the series and the presence of cointegration relationship (Galies, 1997; Mavrotas & Kelly, 2001).

Modified Wald test (MWALD) for the causality test is used as proposed by Toda & Yamamoto (1995) which avoids the problems associated with the ordinary Granger causality test by ignoring any possible non-stationary or co-integration between series when testing for causality. The Toda & Yamamoto (1995) approach fits a vector autoregressive model in the levels of the variables thereby minimizing the risks associated with the possibility of faulty identifying the order of integration of the series (Mavrotas & Kelly, 2001).

4. Empirical results and discussion

4.1. Unit root and co-integration tests

Before I proceed with the ARDL bounds test, I tested for the stationarity status of all variables to determine their order of integration. This is to ensure that the variables are not I(2) stationary so as to avoid spurious results. According to Ouattara (2004) in the presence of I(2) variables the computed F-statistics provided by Pesaran *et al.*, (2001) are not valid because bounds test is based on the assumption that the variables are I(0) or I(1). Therefore, the implementation of unit root tests in the ARDL procedure might still be necessary in order to ensure that none of the variable is integrated of order 2 or beyond. I employed ADF dickey-fuller test to obtain the order of integration of each variable as results shown in Table 2.

Relying on the results of the conducted unit root tests, we conclude that the studied time series are of Same order of integration. According to the results of the ADF test, we have variables (GDP, FDI and Non-Oil Exports) stationary in the first difference I(0).

Table 2. Results of unit-root test (ADF)

Variables	Level ADF test statistics	Lags	First Difference ADF test statistics	Lags
GDP	0.849850	1	-5.531369*	1
FDI	-1.085793	1	-5.579721*	1
NOE	-0.736134	1	-5.702097*	1

Notes: *,** Denotes rejection at 5% and 1% levels, respectively.

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Results of ADF unit root tests shown in Table 1, indicate that the hypothesis that the time series LGDP, LFDI and LNon-Oil Exports are stationary in the first difference can be accepted. Relying on the results of the conducted unit root tests, we conclude that the studied time series are of same order of integration. According to the results of the ADF, tests, we have all variables (GDP, FDI and Non-Oil Exports) stationary in the first difference I(0). has the order of integration I(1) based on the results of the ADF tests.

4.2. ARDL bound test critical values

Maximum 4 lag is used to carry out the find cointegration relationship between variables. Minimum Akaike Information Criteria (AIC) and Schwarz Bayesian Information Criteria (SBC) are used to determine optimal lag length. ARDL(1,0,4) is the optimal model for the cointegration analysis, and there is no autocorrelation problem in this estimated model. Besides, the calculated F-statistic of the model is founded as 30.85176.

Table 3. ARDL bound test critical values

k	F-statistic	10% Significance		5%Significance		2.5%Significance		1%Significance	
		Level		Level		Level		Level	
2	30.85	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
		4.19	5.06	4.87	5.85	5.79	6.59	6.34	7.52

Note: k denotes the independent variables in the model (FDI, Non-Oil Exports).

The long-run co-integration relationship between GDP, FDI and Non-Oil Exports exists. So, the long-run coefficients of the model should be estimated. ARDL (1,0,4) is the optimal lag lengths for the long run model, and its estimation results are showed in Table 4. There is no autocorrelation, heteroskedasticity and normality problem in the long-run estimation. The GDP, FDI and Non-Oil Exports is calculated as 1.00, and it is statistically significant at 10%. According to long-run estimation results, FDI, Non-Oil Exports affects GDP positively.

Table 4. Long-run estimation results

Independent Variables	Coefficients	Probability
GDP(-1)	-0.989097**	0.0247
NOE(-1)	0.483089*	0.0000
C	-1.462408	0.9531
Descriptive Statistics		
R2	0.98	HeteroskedasticityBreusch-Pagan-Godfrey 1.21 [0.31]
Adjusted R2	0.97	Normality (Jarque-Bera) 1.71 [0.45]
Autocorrelation (LM)	4.92 [0.42]	Durbin-Watson stat 1.68

Note: ** and * denote statistical significance at the 1% and 5% levels, respectively. Figures in the square brackets are p-values.

4.3. VECM short run coefficients

After estimating the long-run model, an VECM should be estimated. ARDL(1,0,4) is the optimal lag lengths for the VECM, and its short-run estimation results are displayed in Table 5. This model also passed all the

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diagnostic tests such as autocorrelation, heteroskedasticity, and normality. According to results, GDP, Non-Oil Exports affects FDI in the current year positively as expected. However, its effects are negative in 3 st and 5thlags. The coefficient of $VECM_t$ is estimated as -0.18, it is negative and statistically significant as expected. This result indicates that 18% of disequilibrium is corrected in one year.

Table 5. *VECM short-run coefficients*

Variables	Coefficients	Standard error	t-ststistic
D(GDP(-1))	-0.750005	0.06998	-1.04946
D(GDP(-2))	1.376716	0.71466	1.91474
D(FDI(-1))	-1.802702*	0.71901	-5.82876
D(FDI(-2))	2.354218	0.98575	1.48301
D(NOE(-1))	1.117361**	1.58745	6.48761
D(NOE(-2))	-1.433752	1.48301	-1.99168
C	9.35E+09	1.7E+09	1.21108

$R^2=0.62$. R^2 0.59

Durbin Watson stat = 1.68

Lagrange multiplier (Lag 1)=(0.2214), (Lag 2)=(0.3515), (Lag 3)=(0.7718)

HeteroskedasticityBreusch-Pagan-Godfrey = 0.31

Breusch-Pagan-Godfrey test=(0.4032)

Normality Jarque-Bera test=(0.3421).

*Indicates significant at 1%;

**Indicates significant at 5%;

VECM: Vector error correction model

The results show that GDP has long run relationship with FDI, Non-oil exports. Further, FDI, Non-oil exports positively and significantly affect GDP in the short run as well as in the long run.

4.4. Toda-Yamamoto (1995) causality test

After establishing that a co-integrated relationship between GDP, FDI and Non-oil exports exists, the study proceeded to also test for Toda - Yamamoto causality as introduced by Toda & Yamamoto (1995). Modified Wald test (MWALD) for the causality test is used as proposed by Toda & Yamamoto (1995) which avoids the problems associated with the ordinary Granger causality test by ignoring any possible non-stationary or co-integration between series when testing for causality. The Toda & Yamamoto (1995) approach fits a vector autoregressive model in the levels of the variables thereby minimizing the risks associated with the possibility of faulty identifying the order of integration of the series (Mavrotas & Kelly, 2001). So this final stage of our empirical analysis, we test for the causal relationship among our variables of interest according to Toda & Yamamoto (1995) causality test.

Table 6. *Toda-Yamamoto (1995) causality test*

Null Hypothesis:	Wald test statistic	P-value
D(GDP) does not Cause D(FDI)	2.083446	0.3528
D(FDI) does not Cause D(GDP)	2.772820	0.2500
D(NOE) does not Cause D(FDI)	3.986331	0.1363

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D(FDI) does not Cause D(NOE)	5.343433	0.0491*
D(GDP) does not CauseD(NOE)	7.140083	0.0282*
D(NOE) does not Cause D(GDP)	18.03599	0.0001**

From Table 6, we conclude that for GDP and inflows of foreign direct investment, there is an independent causal relationship between them. Thus, neither is there a causal effect flowing from GDP to inflow of FDI nor is there a causal effect moving from inflow of FDI to GDP at 5% level of significance. And there is a one-way causal relationship between foreign direct investment and non-oil exports. Finally, there is a bidirectional causal effect between Non-Oil Exports and GDP in KSA. Thus, at 5% level of significance, Non-Oil Exports has a causal effect on GDP.

4.5. CUSUM and CUSUMSQ (ARDL 1,0,4)

The stability of the long run parameters were tested using the cumulative sum of recursive residuals (CUSUM) and CUSUM of recursive squares (CUSUMSQ).

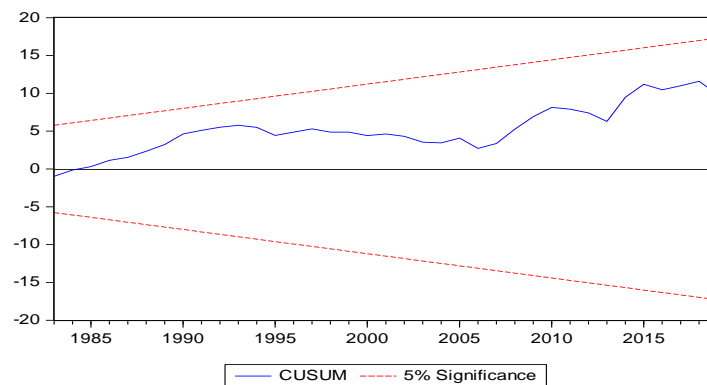


Figure 4. CUSUM

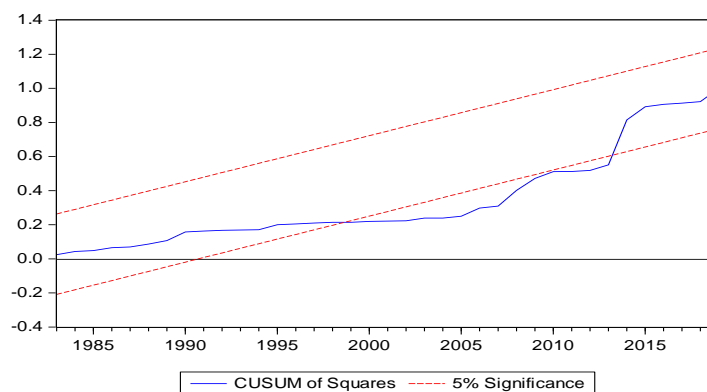


Figure 5. CUSUMSQ

The results are illustrated in Figures 4 and 5. The results fail to reject the null hypothesis at 5 percent level of significance because the plot of the tests fall within the critical limits. Therefore, it can be realised that our selected ARDL (1,0,4) model is stable.

5. Conclusion

Conclusion The paper discusses measuring the relationship between GDP, FDI and non-oil exports in KSA during the period 1970-2019. The long-run relationships between these variables are intriguing and are of acute interest to policy makers. Using the ARDL bounds-testing approach of co-integration, suggested by Pesaran *et al.*, (2001), together with the VECM method, and Toda & Yamamoto (1995) Causality, the study reaches the following conclusions. The ARDL co-integration results showed that GDP, FDI and non-oil exports are co-integrated, indicating the presence of a long-run equilibrium relationship between them. The Toda & Yamamoto (1995), VECM results showed the presence of bidirectional causality between GDP, non-oil exports and a unidirectional causality from FDI and non-oil exports direct investment. A policy implication of this study is that non-oil exports can be considered to be the best policy variable to predict both foreign direct investment and economic growth in KSA. If policy-makers want to maintain sustainable economic growth and high foreign direct investment, they must focus on building non-oil exports in the economy in the longer term. Such a policy could be also supported by infrastructure policy restructuring, especially in the non-oil exports sector, in line, for instance, with the suggestions of Pradhan & Bagchi (2013). This study would be a valuable addition to the growing body of empirical literature on relationship between macroeconomic variables, besides being useful to policy makers, investment community. They should watch out for impact of GDP, FDI in non-oil exports, and oil prices on volatility in the markets.

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Cancelation

This study examines the long-run relationship between GDP, FDI and Non-Oil Exports foreign direct investment, in KSA for the time period 1970 to 2019. In order to assess the long-run relationship, the study used the tests Evidence from (VECM) and (ARDL) and evaluation from Toda & Yamamoto (1995) Causality test.

References

- Al-Khatir, K. (2015). Challenges to oil prices plunge and economic diversification in GCC countries, *The Arab Center for Research and Policy Studies*.
- Belloumi, M., & Alshehry, A. (2018). The impacts of domestic and foreign direct investments on economic growth in Saudi Arabia, *Economies*, 6(1), 1-17. doi. [10.3390/economies6010018](https://doi.org/10.3390/economies6010018)
- Borensztein, E.R., De Gregorio, J.R. & Jongwha, L. (1998). How does foreign direct investment affect economic growth?. *Journal of International Economics*, 45(1), 115-135. doi. [10.1016/S0022-1996\(97\)00033-0](https://doi.org/10.1016/S0022-1996(97)00033-0)
- De Mello, L.R. (1999). Foreign direct investment-led growth: evidence from time series and panel data. *Oxford Economic Papers*, 51(1), 133-151. doi. [10.1093/oeq/51.1.133](https://doi.org/10.1093/oeq/51.1.133)
- Dowling, J.M., & Hiemenz, U. (1982). Aid, savings and growth in the Asian region, Economic office report series 3. Manila: Asian Development Bank.
- Galies, D. (1997). Causality between the measured and underground economies in New Zealand. *Applied Economics Letters*, 4(1), 63-67. doi. [10.1080/758521835](https://doi.org/10.1080/758521835)
- Grossman, G.M., & Helpman, E. (1991). Trade, knowledge spillovers, and growth. *European Economic Review*, 35(2-3), 517-526. doi. [10.1016/0014-2921\(91\)90153-A](https://doi.org/10.1016/0014-2921(91)90153-A)
- Khathlan, K. (2013). Foreign direct investment inflows and economic growth in Saudi Arabia: A co-integration analysis, *Review of Economics & Finance*, 4(1), 70-80.
- Lucas, R.E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1), 3-42. doi. [10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7)
- Mavrotas, G., & Kelly, R. (2001). Old wine in new bottle: Testing causality between savings and growth, *The Manchester School Supplement*, 69(1), 97-105. doi. [10.1111/1467-9957.69.s1.6](https://doi.org/10.1111/1467-9957.69.s1.6)
- Ministry of Finance, KSA, (2019). Budget Statement Fiscal Year 2019. [Retrieved from].
- Pesaran, M., Shin, Y., & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*. 16(3), 289-326. doi. [10.1002/jae.616](https://doi.org/10.1002/jae.616)
- Pesaran, M., Shin, Y., & Smith, R. (1996). Testing for the existence of a long-run relationship. *Faculty of Economics, University of Cambridge*, No.9622.
- Romer, P.M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5), 1002-1037. doi. [10.1086/261420](https://doi.org/10.1086/261420)
- Romer, P.M. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5, Part 2), 71-102. doi. [10.1086/261725](https://doi.org/10.1086/261725)
- Toda, H.Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes, *Journal of Econometrics*, 66(1-2), 225-250. doi. [10.1016/0304-4076\(94\)01616-8](https://doi.org/10.1016/0304-4076(94)01616-8)
- Tarique, M., Alkhateeb, T. (2010). Foreign direct investment and economic growth in KSA: A causality test, *Commercial and Financial Journal*, Egypt.



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