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Article

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High-Technology Exports, Foreign Direct Investment, Renewable Energy Consumption and Economic Growth: Evidence from the United Arab Emirates

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ABSTRACT

Various attempts have been made to undercover the relationship between the UAE's economic growth, FDI, and renewable energy, with inadequate focus on the role of high technology exports in the UAE. This paper, therefore, examines the short and long-term relationship between high-technology exports, foreign direct investment, renewable energy, and economic growth in the UAE for the period 1991-2020. For this purpose, the autoregressive distributed lag bounds testing approach to cointegration has been employed in this study. The short and long-run empirics reveal a positive and significant relationship between high technology exports and the UAE's economic growth. Conversely, a significant negative relationship exists between renewable energy consumption and economic growth. Among various important findings, the long-run causality results show a unidirectional causality exists from high-tech exports to the UAE's economic growth. Further, a bi-directional causality exists between FDI and high-tech exports, that in turn promotes economic growth of the UAE. Based on the overall results, the study provides important policy recommendations.

Keywords: High Technology Exports, Foreign Direct Investment, Renewable Energy, Economic Growth
JEL Classifications: B17, F18, F40, F60, O10, Q20

1. INTRODUCTION

Over the last decade, the United Arab Emirates (UAE) has emerged as a successful economic diversification model to the other Gulf Cooperation Council (GCC) countries. The main driver behind this rapid transformation is the UAE's strategic emphasis on transforming into a knowledge-based economy with rapid technological advancement, innovation, research and development (Al Marri, 2021). The UAE's economy has historically been heavily reliant on oil exports and oil revenues, that are to date utilized for developing alternate sources of economic growth and expanding the non-oil sector (Koch, 2022). Recognizing the volatility of the global oil market and the need for sustainable economic growth, the UAE government has actively pursued economic diversification. From its humble beginnings as a desert nation heavily reliant on oil revenues, the UAE has successfully diversified its economy, laying the groundwork for a sustainable and prosperous future. One key aspect of this transformation has been the strategic emphasis on high technology exports. This shift has been driven by the vision of the UAE's leadership to create a knowledge-based economy that is less dependent on the oil sector. This has not only reshaped the economic landscape of the UAE but has also positioned it as a global player in the realms of innovation and advanced technology. In this context, high-technology exports have played a pivotal role in diversifying the UAE by reducing oil-dependency and generating non-oil export revenues. High technology exports include products such as pharamceuticals, aircraft, computers electronics, and machinery (Kabaklarli et al., 2018). These products require the application of high-technology, innovation, knowledge, and skilled manpower due to the complexities involved in the process of their production.

Over the past few years, high-technology exports have become a driving force behind innovation and technological advancement in the UAE. The nation's commitment to research and development (R&D) in sectors such as aerospace, renewable energy, and biotechnology has enabled the creation of cutting-edge products that cater to both domestic and international markets. In this context, foreign direct investment (FDI) serves as an important source of boosting the production of high-technology exports (for instance, studies by Ozsoy, 2020; Ekananda and Parlinggoman, 2017; Kabaklarli et al., 2018; Asunka et al., 2021; prove the significance of FDI in promoting high technology exports). The UAE's investment in R&D, coupled with its focus on high-technology exports, has fostered a culture of innovation and technology diffusion. In this context, the UAE government has focused largely on the establishment of research centers, innovation hubs, and partnerships with international tech giants to attract FDI and increase high-technology exports. By exporting technologically sophisticated products, the UAE not only gains economic benefits but also creates a conducive and business friendly environment leading to innovation, job-creation and knowledge transfer. High-technology exports have also played a significant role in elevating the UAE's global competitiveness. This diversification strategy has not only stimulated economic growth but has also facilitated foreign direct investment inflows, transfer of skilled human capital and technology, that in turn contribute to the nation's economic growth.

With this backdrop, this study attempts to examine the short- and long-term relationship between high-technology exports and economic growth of the UAE. Apart from this, renewable energy consumption, FDI, inflation, total population and total employment in industry have been taken as control variables. At present, existing research work on exploring the relationship between high technology exports and economic growth is very limited and yields contradicting results (as discussed in the next section). To the best of the author's knowledge, none of the existing studies have examined the impact of high-technology exports on economic growth for the UAE. Therefore, the author aims to meet the above-stated research gap by conducting an empirical analysis.

2. LITERATURE REVIEW

The nexus between high-technology exports and economic growth has garnered very little attention in the available literature and is non-existent in the context of the United Arab Emirates (UAE). The UAE's dynamic economic landscape and ambitious development goals make it a compelling case study. The country's Vision 2021 and Vision 2071 initiatives outline the intent to transition to a diversified, knowledge-based economy while embracing renewable energy sources. For the UAE, promoting export of high-technology exports is one of the strategies to attain economic diversification by shifting away from dependency upon oil exports. High-technology exports are often viewed as indicators of a country's innovation capacity and competitive advantage in the global market. These exports not only contribute directly to economic growth but also stimulate research and development activities, human capital investment, and technological progress. Scholars like Romer (1990) and Mankiw et al. (1992) have long recognized the pivotal role of technological advancements in fostering economic growth through the accumulation of knowledge capital. In order to achieve such technological advancements, an emerging strand of literature have highlighted the role of export diversification and complexity in the composition of export products in promoting economic growth of a country (for instance, Hidalgo and Hausmann, 2009; Zhu and Li, 2017; Stojkoski and Kocarev, 2017; Sciarra et al., 2020; Balland et al., 2022; Britto et al., 2019; Udeogu et al., 2021; Le et al., 2022; Teixeira et al., 2022; Török et al., 2022; Koch, 2021; Pazham and Salimifar, 2016; Ferrarini and Scaramozzino, 2013). This ongoing focus on attaining complexity in export composition has led to the production of high technology exports that require intense research and development, skilled manpower and advanced technology. High-technology export products have witnessed a significant global increase over the last decade as countries aim to achieve sustainable long-run economic growth and international competitiveness by boosting their production. Existing literature on high-technology exports and economic growth is limited in number. Majority of these studies prove that high-technology exports have a positive impact on economic growth. For instance, Abidi (2020) investigated the impact of high technology exports on economic growth of Togo. The findings depicted a positive effect of such exports on economic growth.

In another similar study by Kabaklarli et al. (2018), the authors examined the long-run relationship between high technology exports, FDI, application of patents by residents, gross fixed capital formation and economic growth. Their findings revealed that high-technology exports have a positive impact on the economic growth of selected OECD countries in the long-run. In a comparative case study analysis, Ustabaş and Ersin (2016) attempted to analyse the effects of research and development and high technology exports on the economic growth of Turkey and South Korea for the period 1989-2014. Various time series econometric techniques including unit root tests and cointegration tests were used by the authors to examine the relationship between the variables. The results revealed that high technology exports have a positive and significant impact on the economic growth of South Korea. However, there was no such long-run relationship found for Turkey. As against this finding, a similar study was carried out by Sahin (2019) to examine the effect of high technology exports on the economic growth of Turkey, in which the findings revealed the existence of a positive and significant impact of the former on Turkey's economic growth for the period 1989-2017. Taking Serbia, Bulgaria, Romania and Hungary as case studies, Domazet et al. (2022) studied the impact of high technology on their economic growth. The authors conducted a simple linear regression analysis for this purpose and found that high technology exports have a positive effect on the economic growth of Bulgaria, whereas no such effect was found for the remaining countries.

Besides, in a panel data based study by Gani (2009), the impact of high technology exports on the economic growth was examined for three different group of countries that were classified on the basis of the level of their technological achievement. The findings reveal that there is a positive impact of high technology exports on the economic growth of countries with comparatively larger share of high technology exports. Conversely, there is an insignificant impact of high technology exports on the economic growth of countries with relatively lower share of high-technology exports.

While the above discussed literature provides some insights into the individual relationships among high-technology exports, FDI, economic growth and some other variables, there is a gap in understanding the intricate interplay and potential synergies among these factors within the UAE context. Few studies comprehensively examine how FDI might catalyze high-tech exports and renewable energy adoption simultaneously, and how these dynamics could impact overall economic growth. As the UAE navigates the challenges of economic diversification, technological innovation, and sustainable energy transition, further research is needed to unravel the multifaceted interactions among these variables. To the best of the author's knowledge, this paper is the first attempt to examine this relationship in the context of the UAE.

3. DATA AND METHODOLOGY

This study examines the nexus between high technology exports, renewable energy consumption, and economic growth. In this study, the following model specification has been used to examine the relationship between high technology exports, economic growth, renewable energy and foreign direct investment:

$$GDP_t = f(EXP_t, FDI_t, RE_t, EMP_t, POP_t, INF_t) \quad (1)$$

Here, Gross Domestic Product (at Constant 2015 US $) is the dependent variable and has been used as a proxy measure for economic growth of the UAE. EXP represents Medium and high-tech exports (% manufactured exports) and RE denotes Renewable energy consumption (% of total final energy consumption). These two are the focal independent variables. Besides, following some similar studies, foreign direct investment net inflows (% of GDP), employment in industry (% of total employment), total population growth (annual %) and Inflation, GDP deflator (annual %) have been included as control variables in the empirical model. For the sake of simplicity, Gross Domestic Product (at Constant 2015 US $) has been referred to as GDP, Medium and high-tech exports (% manufactured exports) as EXP, Renewable energy consumption (% of total final energy consumption) as ER, Foreign direct investment, net inflows (% of GDP) as FDI, Employment in industry (% of total employment) as EMP, Inflation as INF and Population as POP. Data for all the above-mentioned variables has been extracted from the World Development Indicators online database. As per data availability, the study uses annual data for the period 1991-2020 to conduct the analyses.

In order to choose between VAR, VECM or ARDL test as an appropriate technique for examining the relationship between high-technology exports, renewable energy consumption and economic growth, this study employs Augmented Dickey Fuller (commonly referred as ADF) (Dickey and Fuller, 1979) and Phillips Perron (PP) Unit Root test (Phillips and Perron, 1988) to ascertain the order of integration of the variables. To estimate the existence of a long-run relationship between the variables, the Auto Regressive Distributed Lag (ARDL) bounds test by Pesaran et al. (2001) has been employed in this study. The Unrestricted Error Correction Model for representing ARDL has been specified in equation two as follows:

$$\begin{aligned}\Delta GDP &= \alpha_0 + \beta_1 GDP_{t-1} + \beta_2 EXP_{t-1} + \beta_3 FDI_{t-1} + \beta_4 RE_{t-1} \\ &+ \beta_5 EMP_{t-1} + \beta_6 POP_{t-1} + \beta_7 INF_{t-1} + \sum\nolimits_{i=1}^{n} \vartheta_1 \Delta GDP_{t-1} \\ &+ \sum_{i=1}^{n} \vartheta_2 \Delta EXP_{t-1} + \sum_{i=1}^{n} \vartheta_3 \Delta FDI_{t-1} + \sum_{i=1}^{n} \vartheta_4 \Delta RE_{t-1} \\ &+ \sum\nolimits_{i=1}^{n} \vartheta_5 \Delta EMP_{t-1} + \sum_{i=1}^{n} \vartheta_6 \Delta POP_{t-1} + \sum_{i=1}^{n} \vartheta_7 \Delta INF_{t-1}\, \varepsilon_t\end{aligned} \quad (2)$$

Here, Δ means change, β denotes the long-run, ϑ stands for the short-run. ε_t denotes the error term.

4. FINDINGS AND DISCUSSION

The descriptive statistics of all the variables have been presented in Table 1.

Results of the unit root tests have been summarized in Table 2. As evident from the table, the order of integration is not uniform since some variables are integrated of order one, whereas others are integrated of order zero. Therefore, findings of both the unit root tests support the application of the ARDL Bounds test model of cointegration propounded by Pesaran et al. (2001).

Before proceeding with the ARDL Bounds test, the optimal lag length selection test has been used to determine the suitable lag length. Table 3 shows the results of the optimal lag length test. Based on the results, the study chooses one as the optimal lag length following the Schwarz information criterion. Using one as the optimal lag length, the study proceeds to use the ARDL Bounds testing model of cointegration (Table 4).

As evident from the results, the null hypothesis of no cointegration is rejected at 10%, 5% and 1% level of significance since the estimated F-statistic is 8.12585 which is greater than the critical values for the lower and upper bound. Therefore, it can be inferred from the results that a long-run relationship between the variables exists.

The coefficients estimated for the long-run model have been displayed in Table 5. The coefficient for RE is −3.63 and is highly significant at 1% level. This study finding conforms to Moorthy et al. (2019); Xie et al. (2020) and Venkatraja (2020). This implies that renewable energy consumption negatively effects economic growth of the UAE. This may be because although the UAE has diversified over the years, oil remains the major source of the country's economic growth and government revenues indicating the economy's heavy dependence upon oil resource.

Table 1: Descriptive statistics

Statistics	GDP	EMP	EXP	FDI	POP	INF	RE
Mean	3.939634	28.90766	19.04314	2.150917	5.289044	3.033286	0.161000
Median	3.755318	28.69567	16.11779	2.174455	4.999872	3.839160	0.110000
Maximum	10.85270	34.67334	50.41904	6.767152	18.12798	18.53335	0.920000
Minimum	−5.242922	24.39442	3.146434	−1.166836	0.779087	−16.26701	0.060000
Std. Dev.	3.866486	2.508941	15.15228	2.149749	4.716120	8.603049	0.182291
Skewness	−0.405743	0.971492	0.993537	0.635771	1.385671	−0.417928	3.274502
Kurtosis	3.139590	3.731547	2.967709	2.418566	4.418552	2.885637	12.92978
Jarque-Bera	0.847493	5.387934	4.936886	2.443607	12.11578	0.889670	176.8625
Probability	0.654590	0.067612	0.084717	0.294698	0.002339	0.640930	0.000000
Sum	118.1890	867.2298	571.2943	64.52751	158.6713	90.99859	4.830000
Sum Sq. Dev.	433.5417	182.5488	6658.158	134.0213	645.0118	2146.361	0.963670
Observations	30	30	30	30	30	30	30

Source: Author's own elaboration

Table 2: Unit root test results

Test	GDP	EXP	EMP	FDI	POP	INF	RE
ADF test statistic							
I (0)	−3.786058***	−1.921943	−4.599741***	−1.640707	−1.444559	−4.014504***	1.862761
I (1)	−5.832013	−5.305563***	−2.117510	−3.201421**	−4.644103***	−7.325201	−3.793894***
PP test statistic							
I (0)	−3.798198***	−1.921943	−1.796036	−1.745512	−1.012237	4.014504***	1.454302
I (1)	−8.186756	−5.307539***	−3.451335**	−4.680512***	−3.067089**	−13.86240	−3.934860***

***, **, and * implies significance at 1%, 5% and 10% level. Source: Author's own elaboration

Table 3: Optimal lag length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−500.7347	NA	13280929	36.26677	36.59982	36.36858
1	−364.6689	194.3798	29647.83	30.04778	32.71219*	30.86231
2	−291.1639	68.25465*	11004.23*	28.29742*	33.29319	29.82467*

*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. Source: Author's own elaboration

Table 4: ARDL bounds test for cointegration

F-statistic	Critical value	Lower bounds value	Upper bounds value	Remarks
8.12585***	1% level	2.88	3.99	Cointegrated
	5% level	2.27	3.28	
	10% level	1.99	2.94	

*** implies acceptance of alternate hypothesis at 1% level of significance. K=6. Source: Author's own elaboration. ARDL: Auto regressive distributed lag

The use of non-renewable energy (oil in UAE's case) serves as a far better and cost-effective source of economic growth and development for the UAE to date. Apropos to EXP, a 1% increase in EXP will bring about a 0.04% increase in the GDP, indicating that high-technology exports boost the economic growth of the UAE. This result is consistent with the findings of Kabaklarli et al. (2018).

The coefficient of FDI is positive and statistically significant at 5% level. The findings show that a 1% change in FDI will increase UAE's GDP by 0.49%. Similar finding for the UAE was obtained in a study conducted by Hassan (2023). Besides, the coefficient of POP is negative and statistically significant at 10% level. The size of POP's coefficient indicates that a percent increase in POP will decrease UAE's GDP by −0.22%.

The remaining long-run coefficients (INF and EMP) of other variables incorporated in the empirical model are insignificant as shown in Table 4.

The study now proceeds to examine the short-run coefficients of the variables determined by the ECM regression part in the table.

The short-run coefficient estimates demonstrate that renewable energy consumption negatively affects the economic growth of the UAE in the short run. The coefficient of RE is −5.06 and is highly significant at 1% level, indicating that a percent increase in RE brings a 5.06% decline in the UAE's GDP. Therefore, RE has a negative impact on the UAE's economic growth, both in the short and long-run in the UAE. In this regard, a study conducted by Moorthy et al. (2019) rightly pointed out that certain economic, technological, social, and regulatory barriers impede the efficient usage and growth of renewable energy consumption. Such countries must, therefore, focus on breaking the above-mentioned barriers and optimizing the use of renewable energy consumption. A negative relationship is also found between population (POP) and the UAE's economic growth – a 1% increase in POP depresses GDP by 0.31%.

Table 5: Long run and short run estimates

(Restricted constant and no trend				
Variable	**Coefficient**	**Std. error**	**t-statistic**	**Prob.**
RE***	−3.635920	0.726151	−5.007110	0.0001
EXP*	0.049050	0.027980	1.753045	0.0957
FDI**	0.498361	0.225703	2.208035	0.0397
POP*	−0.227092	0.129006	−1.760316	0.0944
EMP	−0.010108	0.217690	−0.046432	0.9635
INF	0.077634	0.055036	1.410601	0.1745
C	−4.233587	7.172276	−0.590271	0.5620
EC=LRE - (−0.3263*EMP+0.0677*EXP01+0.1699*GDP−0.0631*INF+0.0855*POP+4.5838)				
ECM regression				
GDP(−1)***	−1.393707	0.212504	−6.558486	0.0000
RE***	−5.067409	1.250714	−4.051613	0.0007
EXP(−1)*	0.068362	0.038782	1.762712	0.0940
EMP	−0.014087	0.303228	−0.046458	0.9634
FDI*	0.694569	0.343577	2.021581	0.0575
POP(−1)*	−0.316500	0.173519	−1.824011	0.0839
INF	0.108200	0.069605	1.554475	0.1366
D (EXP)	−0.061664	0.041179	−1.497439	0.1507
D (POP)*	0.406665	0.195452	2.080641	0.0512
ECT (−1)*	−1.393707***	0.147769	−9.431688	0.0000
R-squared	0.787610	Mean dependent var	4.045826	
Adjusted R-squared	0.771272	S.D. dependent var	3.890148	
S.E. of regression	2.640279	Akaike info criterion	5.046445	
Sum squared resid	132.4504	Schwarz criterion	5.517926	
Log likelihood	−63.17345	Hannan-Quinn criter.	5.194107	
F-statistic	4.642688	Durbin-Watson stat	2.400748	
Prob (F-statistic)	0.002366	Mean dependent var	4.045826	

***, ** and * implies significance at 1%, 5% and 10% level. Source: Author's own elaboration

The findings report a positive and significant relationship between high technology exports (EXP) and the UAE's GDP in the short-run. A 1% increase in the UAE's high technology exports brings an increase of 0.068%. Therefore, it can be stated that high technology exports positively impact the UAE's economic growth in the short as well as long-run. This finding is consistent with the results of Ustabas and Ersin (2016). This result serves as an important indication for the UAE to focus more intensively on increasing high-technology exports to further boost the economy's economic growth. The coefficient of FDI is 0.69% implying that a 1% FDI inflow increases GDP by 0.69%. The coefficient of the Error Correction Term is –1.39 and is highly significant at 1% level indicating the speed of adjustment in case of any disequilibrium.

The study further examines the long-run causal relationship among the variables incorporated in the econometric model. For this purpose, the Toda-Yamamoto Granger Causality (also known as Modified Wald) test has been used. Findings of the test are shown in Table 6. It can be observed from the results that there is a unidirectional causal relationship from high technology exports (EXP) to economic growth (GDP) indicating the importance of high technology exports in boosting the UAE's economic growth and supporting the export-led growth hypothesis. This finding is consistent with the long-run estimates of the ARDL test conducted in the previous section and is in line with the work of (Sahin, 2019; Ekananda and Parlinggoman, 2017; Gani, 2009). A significant bidirectional causality is also found from foreign direct investment net inflows (FDI) to high technology export. This finding is consistent with a similar study conducted by Ali et al. (2023) and Lall (2000). FDI plays a critical role in technological innovations. Countries with traditional economic structure (such as the UAE) lack in terms of capital, skilled manpower and advanced technology. By attracting FDI, such countries are able to retain foreign exchange, knowledge transfer and advancement in existing technology (Ozsoy, 2020). In this context, the long-run bidirectional relationship between FDI and high technology exports serves as an important indicator for the UAE. The UAE has over the years benefitted from FDI by focusing on the production of high-technology goods, technological progress, and transforming into a knowledge-based economy - all of which are some of the major objectives of the UAE's economic diversification policy. Moreover, since a unidirectional relationship is found running from high technology exports to the UAE's economic growth, the finding reveals that there is an indirect relationship between FDI and the UAE's GDP. This is because with the existence of a bidirectional relationship between FDI and high-tech exports, it can be stated that FDI promotes high-tech exports that in turn boost the economic growth of the UAE in the long-run. In other words, the findings indicate that by encouraging technological innovations in the form of high-tech exports, FDI indirectly boosts the economic growth of the UAE.

Another noteworthy observation from the results is that there exists a unidirectional causal relationship from renewable energy consumption (RE) to high technology exports, supporting growth hypothesis. This result is similar to the finding reported in a study carried out by Waheed et al. (2021). A unidirectional causal relationship runs from population growth (POP) and inflation (INF) to employment in the industrial sector (EMP).

Table 6: Toda Yamamoto granger causality test results

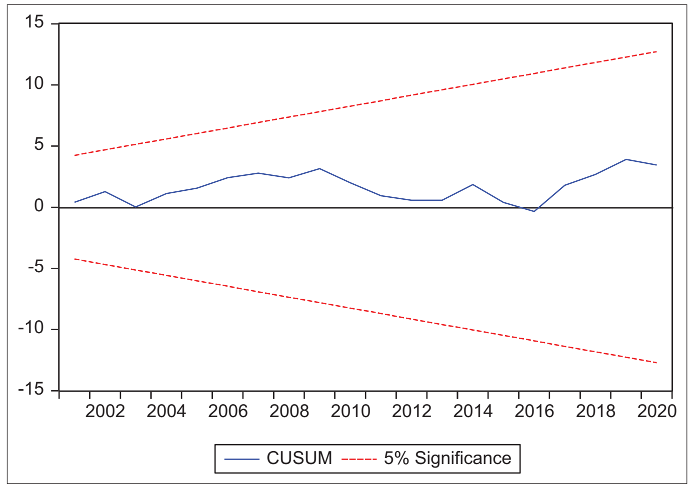
Excluded	Chi-square	df	Prob.
Dependent variable: GDP			
EXP	3.456074	1	0.0630*
EMP	0.189995	1	0.6629
FDI	1.950855	1	0.1625
RE	1.333183	1	0.2482
POP	1.302066	1	0.2538
INF	0.023373	1	0.8785
All	10.00091	6	0.1246
Dependent variable: EXP			
Excluded	**Chi-square**	**df**	**Prob.**
GDP	1.967953	1	0.1607
EMP	0.238060	1	0.6256
FDI	3.447772	1	0.0633*
RE	3.037387	1	0.0814*
POP	0.041992	1	0.8376
INF	0.633091	1	0.4262
All	5.743147	6	0.4526
Dependent variable: EMP			
Excluded	**Chi-square**	**df**	**Prob.**
GDP	1.869951	1	0.1715
EXP	0.453573	1	0.5006
FDI	2.528492	1	0.1118
LRE	0.287809	1	0.5916
POP	2.984076	1	0.0841*
INF	5.077636	1	0.0242**
All	9.064733	6	0.1700
Dependent variable: FDI			
Excluded	**Chi-square**	**df**	**Prob.**
GDP	0.354711	1	0.5515
EXP	4.500461	1	0.0339**
EMP	0.908328	1	0.3406
RE	0.352431	1	0.5527
POP	0.194463	1	0.6592
INF	6.688239	1	0.0097***
All	8.500388	6	0.2037
Dependent variable: RE			
Excluded	**Chi-square**	**df**	**Prob.**
GDP	6.995265	1	0.0082***
EXP	0.002045	1	0.9639
EMP	0.143218	1	0.7051
FDI	9.009965	1	0.0027***
POP	0.605651	1	0.4364
INF	0.421768	1	0.5161
All	15.45882	6	0.0170***
Dependent variable: POP			
Excluded	**Chi-square**	**df**	**Prob.**
GDP	0.491572	1	0.4832
EXP	0.078599	1	0.7792
EMP	1.444070	1	0.2295
FDI	1.86E-05	1	0.9966
RE	0.086054	1	0.7693
INF	2.079065	1	0.1493
All	10.02642	6	0.1235
Dependent variable: INF			
Excluded	**Chi-square**	**df**	**Prob.**
GDP	1.218856	1	0.2696
EXP	0.321024	1	0.5710
EMP	0.009476	1	0.9225
FDI	4.978700	1	0.0257**
LRE	0.898175	1	0.3433
POP	0.471087	1	0.4925
All	5.830195	6	0.4425

***,**, and * implies significance at 1%, 5% and 10% level. Optimal lag length=1.
Source: Author's own elaboration

Table 7: Result of stability tests

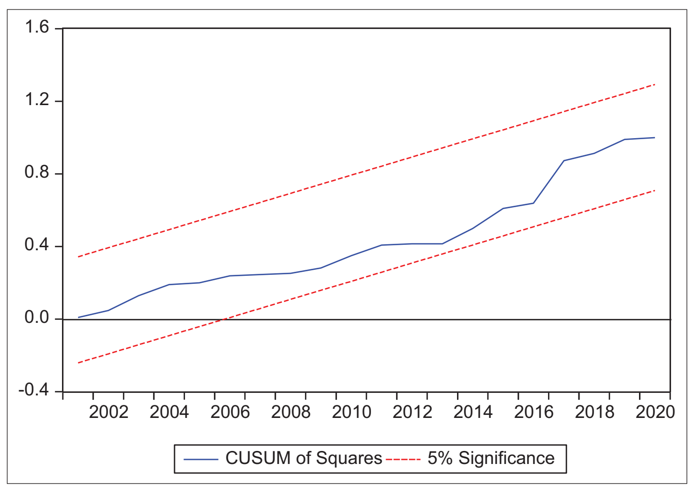
Stability test	P-value
1. Jarque Bera Test statistic: 3.8800323	0.143681
2. Heteroskedasticity Breusch Pagan Godfrey Test statistic: 0.884706	0.5555
3. Serial Correlation LM Test Test statistic: 2.495004	0.1316

Figure 1: Plots of CUSUM



Source: Author's calculations

Figure 2: Plots of CUSUM of squares



Source: Author's calculations

The results also reveal that a highly significant unidirectional causal relationship runs from GDP to renewable energy, supporting conservation hypothesis. This empirical finding is similar to the result of (Saad and Taleb, 2018). Also, a unidirectional causality is found running from FDI to renewable energy at 1% level of significance. Lastly, a bidirectional causality is found between FDI and inflation.

In order to check reliability of the results, diagnostic tests were applied on the model. The findings of the diagnostic tests are reported in Table 7 and demonstrate that the model is normally distributed. Also, it is from the presence of heteroskedasticity and serial correlation.

To further test the stability of the results, the Cumulative Sum of recursive residuals and square of cumulative sum of recursive residuals tests have been employed. As evident from Figures 1 and 2, the parameters of the model are constant, indicating stability of the model.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study examined the short and long-term relationship between high-technology exports, foreign direct investment, renewable energy, and economic growth in the UAE for the period 1991-2020. For this purpose, various econometric techniques were employed including the ADF and PP Unit Root test, Autoregressive Distributed Lag Bounds testing approach to cointegration, Toda Yamamoto granger causality test and some diagnostic tests. The long-run empirics of the ARDL test revealed a significant and negative impact of renewable energy consumption on the UAE's economic growth. This maybe because the UAE's economic structure is still traditional in the sense that the economy is still heavily oil-reliant. Despite various initiatives taken by the UAE government to diversify the country's economic base, the oil sector remains the largest contributor in the total GDP. Therefore, it is recommended that the UAE government must continue to actively focus on reducing oil dependency, introducing appropriate strategies to promote the use of renewable energy while also ensuring that the economic growth remains stable and sustainable in the long-run.

Besides, the ARDL short and long-run estimates of the coefficient bring out two important findings. The results show that FDI significantly and positively increases economic growth of the UAE in the long-run as well as in the short-run. Similarly, high technology exports promote economic growth of the UAE in both, the short and long-run. Similarly, the findings of long-run causality test revealed a two-way causal relationship between FDI and high technology exports. Furthermore, a one-way causal relationship was found from high technology exports to the UAE's economic growth. Therefore, it can be inferred from the above findings that FDI serves as a major source of promoting high technology exports in the UAE. In this way, FDI also indirectly promotes sustainable long-run economic growth in the UAE. It can be stated that FDI plays a crucial role in helping the UAE attain economic diversification by boosting high-tech exports as well as economic growth and reducing oil-dependency and step towards a more diversified, resilient and modern economic system. According to the UAE's Ministry of Economy, the country secured first position in FDI inflows among the middle east countries in 2020. Further, it secured highest-ever FDI inflows in 2022, despite a world-wide decline in the FDI flows during the same period.

Keeping the above findings in view, the author recommends that the government should focus on bolstering FDI inflows in the economy and implement appropriate initiatives and policies to boost FDI in the long-run. Special focus may be given to investments that would lead to increase in the production of high-technology in the UAE. In conclusion, the UAE's journey towards economic diversification and innovation is intricately linked to its focus on high-technology exports. This strategic approach has not only fueled economic growth and resilience but has also nurtured a culture of innovation and positioned the UAE as a competitive force in the global arena. As the UAE continues to leverage its technological prowess, it stands poised to shape its own destiny as a trailblazer in the realm of high-technology exports. While the emphasis on high-technology exports presents a promising path for the UAE's economic development, there are challenges to consider. Ensuring a skilled and adaptable workforce, sustaining investment in R&D, and addressing potential environmental impacts of technological growth are among the challenges that require attention.

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