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The Effect of Direct and Freezone Company Structures on Trade in the UAE during the Covid Pandemic

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Abstract

The trade settings and wide-ranging shocks are key in the evaluation of economic resilience and long-term policy. This paper discusses the impact of COVID-19 on imports, exports and jobs in both direct (onshore) and free-zone company arrangements in the UAE. The purpose is to identify the response of these different trade environments to an unprecedented global shock and to see what structural weaknesses arose during and after the crisis. Interrupted Time Series Analysis had been used to analyze the data from 2011 to 2023 annually, understanding the way trade patterns have changed before and after the onset of the COVID-19 pandemic. The results show the main economic indicators of the UAE in trade and exports which are total imports, direct imports, free zone imports, UAE non-oil exports, and UAE GDP. It was observed that there was an increased trend in total imports shortly after the pandemic began. This evidence indicated that economic policy after the pandemic needs to focus on stabilization of import levels and building long-term resilience of trade, rather than stimulating trade in the shorter term. These results highlight the importance of implementing strategic changes that will focus on economic diversification, strategic planning, and empowerment of the non-oil sector. The insights obtained can be of great value to policy makers, investors, and logistics practitioners who are determined to make the UAE economy more resilient.

Keywords: *Freezones; ITSA; Import; Export; Direct; UAE*

Introduction

The COVID-19 pandemic placed significant restrictions on both developed and developing countries, doubling up the existing problems regarding trade and transportation (Zhu et al., 2020). The interruptions of logistics as well as the adjustments in health guidelines and security conditions negatively impacted the production, transport, and international trade (Bonadio et al., 2021). The pandemic showed the complex nature of global supply chains and how shocks experienced in one location can quickly spread to other locations, thus creating strong economic effects (Lin, 2023). Make-to-order industries proved to have severe shortages, which showed the systemic vulnerabilities and reliance on the particular

suppliers or regions to get the important inputs (Shekarian et al., 2022). The UAE, which depends heavily on the maritime transport, faced challenges due to the global congestion of ports, delays during containers delivery, and limited crew rotations (Majune & Montfaucon, 2023). The problems hindered the re-export operation and unveiled the weaknesses in maritime logistics (Rashid, 2022). Air transport, on the other hand, was relatively reliable during the pandemic, allowing transporting high value and time-sensitive products even in the context of massive sea-shipping delays (Majune & Montfaucon, 2023), which gives it a strategic edge in maintaining supply chains (Rashid, 2022). The urgency of the technology adoption, process automation, and advanced logistics systems became evident during the pandemic (Onjewu et al., 2022). Countries and companies that have well-developed digital bases may have the capacity to trace goods more accurately, create more stable demand projections, and act rapidly to supply chain disturbances, reducing their negative effects on commerce and manufacturing. This event highlighted that sound policy frameworks and governments should support trade, as was seen in the case of the UAE with its national strategy that boosted efficiency and the ability to sustain international trade during the crisis (Rashid, 2022). The consequences of supply-chain failures across global delivery networks can be mitigated with the help of rapid technological shifts and increased attention to digital solutions (Shekarian et al., 2022). The disruptions in supply-chain were presented worldwide, with the vulnerability being dependent on the dependence of a country on imports or exports (Zhu et al., 2020). The impact of that on import-dependent countries was more severe because of decreased availability of domestic production, but on the export-dependent countries, it could react more quickly to the shifts in the production capacity in the sectors of highly demanded goods, thus, satisfying global needs in terms of essential commodities (Hayakawa & Mukunoki, 2021).These trends not only reflected the unevenness of the global pandemic experience and response but highlighted the composition of trade structures on the basis of a country's resilience (Lin, 2023). The UAE's place in the global structure as a hub for both domestic end-consumption and international re-distribution produced some unique challenges and benefits (Rashid, 2022). The UAE's position in global trade networks made its economy a shock-susceptible point, but it also provided openings for recovery quickly for those few firms who focussed on its operations (Zhu et al., 2020). A free trade zone (FTZ) is a clearly defined area within a country's customs territory, usually in a good location, having the right setup for trade and industry. Such regions have special customs and tax regulations (UN ESCAP, 2005). The pandemic was resilient with the assistance of institutional arrangements, specifically free zones (Vanzuela & Rivera, 2022). Free trade zones helped business to carry on with their usual business with the least possible interference and resources to be flexible by waiver of fees and postponed fees and other services which are aimed at service providers (H & Devi, 2024). As a result, it is these areas that acted as working cushions, that is, protecting the trading businesses against the worst effects of the world crisis, thus, providing a business with more competitiveness and adaptability during extended economic downturns (Sagawe, 1996). The companies in such zones noted a significantly lower rate of operational disturbance than companies operating in the onshore economy and they showed the benefits of having an institutional landscape that is not only flexible regarding regulation, but also supportive of trade and therefore stabilising and facilitating trade in time of crisis (Murtha, 1993). Another weakness of global supply chains during the COVID -19 period was the risk of dependency on a given region and suppliers, as this time demonstrated (Zhu et al., 2020). Companies diversifying their sources of supplies, creating and sustaining safety stock, and redesigning their logistics systems proved to adapt faster to the changing market needs (Onjewu et al., 2022). The flexible ones, which incorporated flexibility into their trading modalities, not only managed to stay resilient but enabled the trading activity and had a faster recovery compared to their less flexible partners (Shekarian et al., 2022). The pandemic highlighted how sensitive a supply chain, especially one that involves a trader working in a number of countries (Hayakawa & Mukunoki, 2021). The disruptions in one nation can prove to be uncontrollable in a global scale; geographically separated nations are the sources of supply chains of both intermediate and end products, but at the same time they are suffering severe delays in the bottlenecks which hamper economic operations in all the nations concerned (Zhu et al., 2020). The case of the United Arab Emirates (UAE) can serve as an illustration of how to effectively address such vulnerabilities, which was possible due to strategic position, a wide range of transport,

digital infrastructure and strong institutional support that ensured the continuity of trade (Rashid, 2022). Technology was instrumental, particularly in the presence of digital tracking (including distribution of tracking information), automated logistics, and data-driven predictions, allowing companies to respond more to changes in the situation, allocate resources more effectively and reduce the negative consequences of slowness and shortages (Onjewu et al., 2022). The UAE companies have been dependent on risk-management structures that included supplier diversification, inventory building and restructuring of the logistics. The pandemic also demonstrated industry-specific differences in resilience; industries that produce the most important commodities, such as medical supplies, had fewer negative consequences and greater demand and other industries had larger production slowdowns or shutdowns (Lin, 2023). The influence of free zones and investments in digital and automated logistics systems helped the UAE to maintain trade and supply-chain operations despite the pressure experienced throughout the world (Vanzuela & Rivera, 2022). These zones, together with governmental policy, offered structural and operational support, including short-term shock-absorbing potentials and long-term institutional gains that emphasized the ability of the UAE to react to the current and future disruptions (H & Devi, 2024). The example of the UAE shows that a mix of geo-graphical positioning, infrastructure, institutional support, and technological investment allowed alleviating the effects of shocks, maintaining trade and facilitating economic revival (Rashid, 2022). Flexibility, transparency, and resilience during the construction of supply chains were also highlighted as a requirement of the pandemic (Zhu et al., 2020). Those countries and organisations that had developed such qualities were in a better place to react rapidly to short-term shocks, applying their plans that led to quick recovery (Onjewu et al., 2022). Operational and strategic responsiveness are functional characteristics of resilience, which depends on policy and technology (De Lucio et al., 2023). The UAE experience of overcoming the COVID-19 pandemic highlights the necessity to incorporate a variety of resilience layers as a part of the national and corporate supply-chain systems (Rashid, 2022). The goods flow, vulnerability displacement, and proactive ability to react to disruptions in the world should be interconnected: technology, policy, and organisational strategies (Shekarian et al., 2022). The pandemic redefined what it takes to continue trade flows and prove that a proactive, well-supported, and technology-driven strategy to reduce the risks of global shocks, quicken recovery, and stay competitive despite the rising uncertainty (Lin, 2023). The results of management of trades and logistics in the UAE under severe conditions provide important lessons to the countries that want to develop more resilient supply chains and economic policies. The key to reducing the effects of the future crisis is the strategic foresight, the investment in the digital infrastructure, institutional structures such as free zones, and flexible networks (Vanzuela & Rivera, 2022). In this case study, the significance of diversification of trade routes and partners is recorded, so that even in the event of a significant upheaval, trade is not paralyzed (Majune & Montfaucon, 2023). Combined efforts are made concerning transport, technology, and policy which will protect economic activity and global interconnections in the event of extreme situations (H & Devi, 2024). The study is useful as it explains how free zones affect the trade performance in the global uncertain environment, outlines their advantages and weaknesses, and guides business practices and policymaking in order to enhance the trade and economic resilience. The results will also assist the investors, logistics managers, and those conducting research on the global trading systems with some evidence supporting the reaction of different trade environments to disruption. The current paper is dedicated to companies operating in the UAE and involved in importing and exporting, comparing the work of the companies inside and outside the free zones. It assesses performance of trade in the COVID-19 pandemic to clarify how disruption affects supply chains.

Literature Review

The growing access to scholarly literature has clarified the way that the lessons learned throughout the COVID-19 pandemic can be implemented to strengthen international supply chains and trade policies in developed and developing countries with a focus on the United Arab Emirates, other Gulf countries, and the new economies in Asia (Lin, 2023). An examination of the literature has questioned how the

manufacturing, transportation, and trade sector in various regions of Asia and Europe will be affected by logistical bottlenecks, the dynamic health protocols, and heightened security measures (Paché, 2020). The existing literature shows that the decline in trade that has been witnessed within the first few months of the pandemic revealed how vulnerable the world has become with highly interconnected networks (Lin, 2023). Indeed, empirical studies suggest that the heavily manufacturing-based supply chains that are relying on order provision are particularly vulnerable to cascading delays in Europe, Africa, and Asia (Shekarian et al., 2022). As recent evidence indicates, the UAE as a central node between Asia, Europe, and Africa underwent significant trade shocks but it also witnessed resilience that can be explained in terms of its strategic location in global logistics (Sokolova et al., 2025). Research conducted in the Middle East revealed that the maritime shipping delays, the lack of containers, and the ban on the change of the crews during the pandemic has significantly hampered trade in the UAE (Majune & Montfaucon, 2023). Previous research also shows that the air transport network in the UAE ensured the critical flows of high-priority goods, hence, showing a specific degree of operational resilience compared to the maritime shipping (Rashid, 2022). Different studies have been conducted on how the different resilience of various means of transportation highlights the different effects of global shocks on logistics networks (Bonadio et al., 2021). A persistent controversy among researchers is the position of policy interventions and digital technologies to counter such shocks; the example of the UAE applying automation and digital technologies to strengthen supply chains is such (Onjewu et al., 2022). One of the studies concerned the UAE and how proactive national policies, combined with developed logistics frameworks, helped to keep the economy stable in the circumstances of widespread disruptions (Rashid, 2022). The available literature also hints at the fact that the global interdependence increased the speed of spread of supply and demand shock, which influenced the trade of intermediate products and cross-border production networks (Hayakawa & Mukunoki, 2021). Critical countries disrupted entire production triggered various disruptions in Africa, Asia, and Latin America, leading to the realization of the dangers of highly integrated supply chain (Zhu et al., 2020). A study that was conducted in South and Southeast Asia examined the imbalance in trade in terms of essential goods and found that the exporter-dependent economies had better time recovering in the foundational sectors, as opposed to the import-dependent economies, who experienced long-term disruptions (Hayakawa & Mukunoki, 2021). The recent discoveries also suggest that the structure of trade and the dependence on global value chains had a significant effect on the national resilience during the pandemic (Lin, 2023). Some of these studies have conducted rigorous research on how institutional arrangements, including free zones, helped companies in both maintaining operations and going through economic shocks, providing examples of the UAE and other regions of the Middle East (Vanzuela and Rivera, 2022). The study of H. and Devi (2024) is a higher-order evaluation of the effectiveness of policy solutions, such as licensing waivers, fee deferrals, and special support of service-based businesses in the stability of trade in economically difficult times. Empirical research indicates that procedural streamlining, political coordination and availability of soft infrastructure in free zones are some of the factors that lead to corporate resilience and competitive advantage (Sagawe, 1996). Various studies have shown that companies located in the free zones were less affected, and sustained business operations longer than similar companies in onshore regulatory systems (Murtha, 1993). The most current literature has found the shock absorber role of free zones in enhancing their emergent role in global logistics to explain how both countries and firms can be shielded by strategically designed institutions against systemic shocks that are not visible to a logistics network (Vanzuela and Rivera, 2022). Onjewu et al. (2022) investigated how companies managed to optimum implement digital tools and automation in the logistics system to support more successful cross-border trade and maintain continuity during the pandemic. The literature reveals the differences in trade recovery among nations and regions, stating that the economy with the diversified supply chains, high-quality digital infrastructures, and overall policy frameworks had comparatively positive results. Empirical studies show how the UAE experience emphasises the importance of combining strategic policy interventions with adoption of technology and institutional support in promoting resilience. The emerging information is that resilience in the context of a worldwide stimulus not only relies on the utilization of digital instruments but also the institutional aspect of establishing trade networks, governance, and

mobilization potential in disruptive situations. These lessons have realistic connotations to inform the future conduct in international trade through their promotion of active risk management of supply chains and investment in information-technology infrastructures in Asian, Middle Eastern, and African locations. Empirical results also highlight the fact that the understanding of the intersection between trade structure, policy actions, and logistics capabilities can be used to strengthen global trade resilience to future pandemics or global shocks (Hayakawa and Mukunoki, 2021). The studies in Southeast Asia and the Middle East indicate that the regional coordination and adoption of technology proved to be the key to addressing the worst consequences of disruption (Rashid, 2022). Previous studies show that institutional support, digital technologies, and supply-chain flexibility were the critical variables that allowed firms to respond to the impulsive shock and remain afloat, which substantiates the significance of local and global strategic considerations (Onjewu et al., 2022). The combination of these has resulted in long-term stability, and the diversified trade routes, advanced digital technology, and friendly policies have placed the countries in an advantaged position to face the future worldwide shocks (Vanzuela & Rivera, 2022). More studies are still justified with regard to the connection between trade-policy evolution, technology adoption, and logistics to enhance the resilience of the supply chain in the UAE and similar economies across the globe (De Lucio et al., 2023). Free trade zones have also allowed companies to be more flexible and policy tolerant, which continues to export operations even in the face of temporary and widespread lockdowns (Rashid, 2022).

Methodology

Research Design

A quantitative research design is adopted by the study which aims at determining the effects of the structures of direct and free-zone companies on the import and export performance of the United Arab Emirates (UAE) in the period of 2011-2023, especially in the period before and after the COVID-19 outbreak. Considering the disturbance that is inherently created by the COVID-19 pandemic in 2020, the quasi-experimental time-series design is used to compare the trends reported in the pre-pandemic era and the post-pandemic era.

Data Collection

The secondary macroeconomic data were obtained through an official government repository in the UAE thus relaying reliability and validity. The data will include the period of 2011-2023 and will have enough observations prior and after the COVID-19 intervention point.

Variables

The variables to be used in the study are:
- Total Imports
- Direct Imports
- Free Zone Imports
- Total Non-oil Exports
- Direct Non-oil Exports
- Free Zone Non-oil Employment
- Direct Exports
- Free Zone Exports

Model Specification

The following key variables were included in the model:
Time: A continuous variable representing equally spaced time units (years).
Post-COVID: A dummy variable where 0 represents pre-COVID years and 1 represents post-COVID years (starting 2020).

Time_Post_COVID: Interaction term between time and post-COVID to measure the slope change after the intervention.

The general regression model employed is:

$\ln(Y) = \beta_0 + \beta_1.(\text{time}) + \beta_2.(\text{post\_covid}) + \beta_3.(\text{time\_post\_covid}) + \varepsilon$

Analytical Procedure

Interrupted Time Series Analysis (ITSA) is used in the study to address the impact of the COVID-19 pandemic on UAE trade indicators. ITSA is a stringent quasi-experimental design that is applicable in the study of the effect of a clear exogenous shock that is the COVID-19 pandemic on longitudinal data. The approach would allow predicting the changes at level and the changes in the trend that would follow the intervention in addition to taking into consideration the existing trend of the economy in the past.

Data Transformation

Since a lot of skewness is common in economic variables, all the dependent variables were log-transformed prior to analysis. Logarithmic transformation maximises normality, empowers variances, and makes percentage-based decisive reading of coefficient estimates, which serves as a strong force of ITSA methodology used to evaluate structural changes in imports and exports in the UAE.Model Specification

Analysis

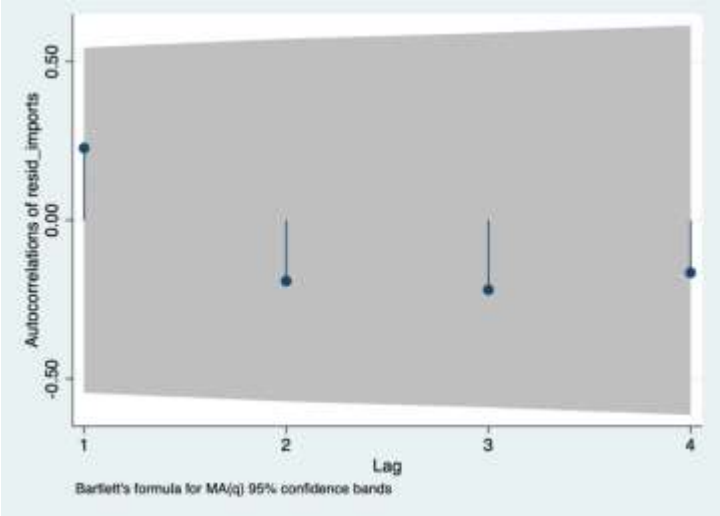
The data range is from 2011 to 2023. It shows the main economic indicators of the UAE in trade and exports. Some of the economic indicators in this analysis are total imports, direct imports, free zone imports, UAE non-oil exports, and UAE GDP, whose logarithms have been taken for regression purposes.From the descriptive statistics involved, vast variability of the data is evident from the standard deviations, hinting towards dynamic trends in trade patterns over the years.

Table 1
Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
TotalImports	13	274389.85	48959.22	223740	405734
DirectImports	13	185173.69	25709.501	150894	251551
FreezoneImports	13	89216.308	25593.542	62007	154184
TotalNonoilExports	13	64696.231	25659.552	34338	119722
DirectNonoilexports	13	55305.077	21075.408	31046	100031
FreezoneNonoilEmp	13	9391.154	4763.037	3292	19691
TotalExports	13	129329.31	26688.214	94739	186317
DirectExports	13	65522.154	10686.811	48994	88155
FreezoneExports	13	63807.231	17537.634	37341	98162
GDPOFUAE	13	3.325	3.341	-4.95	7.5
lTotalImports	13	12.51	.16	12.318	12.913
lDirectImports	13	12.121	.13	11.924	12.435
lFreezoneImports	13	11.367	.252	11.035	11.946
lTotalNonoilExports	13	11.013	.365	10.444	11.693
lDirectNonoilExports	13	10.861	.35	10.343	11.513
lFreezoneNonoilEmp	13	9.03	.509	8.099	9.888
lDirectExports	13	11.079	.156	10.799	11.387
lFreezoneExports	13	11.03	.27	10.528	11.494

The Durbin–Watson statistic was 0.93, far lower than the critical value of 2. Given that values close to 0 revealed a strong positive autocorrelation whereas values close to 2 revealed no autocorrelation, and

values approaching 4 suggest negative autocorrelation, the observation indicated there is strong positive autocorrelation in the residuals of the regression model.



Graph 1: ACF Plot

Durbin–Watson tests and autocorrelation function (ACF) plots were utilized to check for autocorrelation in the time series data. VCE robust standard errors were applied to address heteroskedasticity and autocorrelation. Model fit was assessed by the R-squared values, F-tests. Sensitivity analysis was implied by a check for consistency of results across multiple related dependent variables. The statistical analysis was performed using STATA 17 software, in correspondence with the command structure designed for ITSA:reg lnDependentVar time post_covid time_post_covid, vce(robust). ACF plot shows that during the Lag 1, autocorrelation is slightly positive, close to 0, and within the non-significant band which is not significant statistically. The Lag 2 shows that the autocorrelation is negative but within the non-significant band. The Lag 3 is negative, within the non-significant band. The Lag 4 is extremely small, well within the band that isn't significant. The autocorrelations are all none that fall outside the 95% confidence bands. This shows that the residuals are approximately white noise i.e no significant autocorrelation is found. That is, the fitted model seemed to have been able to capture the time dependence of the data well.

Table 2
Impact on Total Imports (lnTotalImports)

lTotalImports	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.01	.008	-1.25	.241	-.028	.008	*
post_covid	.582	.068	8.51	.000	.427	.737	***
time_post_covid	-.189	.011	-16.85	.000	-.215	-.164	***
Constant	12.547	.064	195.45	.000	12.402	12.692	***

Mean dep. var	12.510	SD dep. var	0.160
R-squared	0.944	Number of obs	13
F-test	228.697	Prob > F	0.000
Akaike crit. (AIC)	-41.365	Bayesian crit. (BIC)	-39.105

*** p<.01, ** p<.05, * p<.1

The post-COVID dummy variable is highly significant with p<0.01 and has a positive coefficient value of 0.582, which implies an increased trend in total imports shortly after the pandemic began. The

interaction term (timepostcovid) has a significant negative coefficient (-0.189, $p < 0.01$), indicating that total imports seen a decline subsequent to the initial post-COVID surge. The model accounts for a good portion of the variance ($R^2 = 0.944$), suggesting an adequate fit. Using the linear regression model we account the determinants of the log of total imports in the UAE, including COVID-19 and the effect of and with respect to the COVID-19 pandemic. Time Variable (Coef. = -0.01, $p = 0.241$), The coefficient of the time variable is negative and is non-significant ($p = 0.241$), indicating that prior to the pandemic there had been no significant linear trend with respect to time. A small negative coefficient indicates a very slight decrease, but this is not significant. Post-COVID Effect (Coef. = 0.582, $p < 0.01$) The dummy variable post_covid is highly significant (*** $p < 0.01$) and has a positive value of 0.582. This implies that immediately following the emergence of the pandemic, aggregate imports increased hugely, by approximately 58.2% in log form, compared to the pre-COVID period. This can be attributed to policy responses such as easing import restrictions or increased demand for medication and basic goods amid the pandemic. Interaction Term (time_post_covid: Coef. = -0.189, $p < 0.01$). The connection between time and the post-COVID period is extremely negative and meaningful (*** $p < 0.01$). This indicates that during different time periods, the post-COVID import boom decreased steadily by 18.9% with each time unit. This pattern highlights the transitory nature of the COVID-occasioned import boom. Constant (Coef. = 12.547, $p < 0.01$) The constant is highly significant and refers to the estimated logarithm of total imports at the reference point (when all independent variables are zero). The model explains 94.4% of the variation in total imports ($R^2 = 0.944$). The F-test ($F = 228.697$, $p < 0.001$) confirms that the model is statistically significant in general.

This research demonstrates a big but temporary impact of the COVID-19 pandemic on the total imports of the UAE. A sharp, positive increase in the total imports was felt shortly after the pandemic started. The increase was short-lived, though, as the negative and statistically significant interaction term indicates a slow return to pre-COVID levels. The statistically significantly small effect of the time variable after the pandemic indicates that structural changes in aggregate imports were mainly caused by the pandemic event rather than a long-term trend. This evidence indicates that economic policy after the pandemic needs to focus on stabilization of import levels and building long-term resilience of trade, rather than stimulating trade in the shorter term

Table 3
Impact on Total Non-oil Exports (lnTotalNonoilExports)

lTotalNonoilExp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.057	.017	-3.35	.009	-.095	-.018	***
post_covid	.547	.131	4.18	.002	.251	.843	***
time_post_covid	-.104	.024	-4.31	.002	-.158	-.049	***
Constant	11.323	.127	89.09	0	11.035	11.61	***

Mean dep. var	11.013	SD dep. var	0.365
R-squared	0.951	Number of obs	13
F-test	251.181	Prob > F	0.000
Akaike crit. (AIC)	-21.410	Bayesian crit. (BIC)	-19.150

*** p<.01, ** p<.05, * p<.1

Table 3 shows that Both post-COVID (coef. 0.547, $p < 0.01$) and time_post_covid (coef. -0.104, $p < 0.01$) are significant. The negative time interaction implies that the expansion of non-oil exports after Cov id-19 had been declining over time and at a decreasing rate. The model fits well dimensionally as indicated by R^2 = 0.951. The regression model looks at the factors influencing the logarithm of total non-oil exports in the UAE including the direct impact of the COVID-19 pandemic and its effects. Time

variable (Coef. = -0.057, p = 0.009). The time mentioned is statistically significant at the 1% level. This shows there is a declining trend to the year-on-year sum of non-oil exports when controlling for the COVID-19 effect. Specifically, each year is negatively associated at 5.7% with the log of the year-on-year total non-oil exports, this is indicative of structural factors generating declines even before COVID-19.Post-COVID Effect (Coef. = 0.547, p = 0.002). The post_covid dummy variable captures the immediate impact of the pandemic on non-oil exports. The statistically significant and positive coefficient (*** p < 0.01) indicates that immediately there was a sudden sharp peak in total non-oil exports—approximately 54.7% higher in log form—relative to prior to COVID, shortly after COVID-19 started. This may be a policy or market reaction at the beginning that temporarily artificially propped up exports during the pandemic period. Interaction Term (time_post_covid: Coef. = -0.104, p = 0.002). The significant negative interaction term between post-COVID period and time (*** p < 0.01) indicates that the positive impact of the pandemic was not long-lasting. This effect declined by 10.4% for every unit of time by time. This means that the initial boost in non-oil exports following COVID-19 was temporary, and the general downward trend resumed its dominance in the post-COVID period.Constant (Coef. = 11.323, p < 0.01)The constant is large and by definition is the log of total non-oil exports at baseline (when all independent variables are zero).The model has a good fit with 95.1% of the variance in the dependent variable being explained (R^2 = 0.951). The F-test (F = 251.181, p < 0.001) confirms the general model to be highly significant.

Table 4
Impact on Free Zone Non-oil Employment (lnFreezoneNonoilEmpl)

lFreezoneNonoil Emp~s	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.129	.018	-7.10	0	-.171	-.088	***
post_covid	.152	.162	0.94	.374	-.215	.52	
time_post_covid	-.077	.026	-2.99	.015	-.136	-.019	**
Constant	9.949	.159	62.43	0	9.589	10.31	***

Mean dep. var	9.030	SD dep. var	0.509
R-squared	0.962	Number of obs	13
F-test	199.465	Prob > F	0.000
Akaike crit. (AIC)	-16.354	Bayesian crit. (BIC)	-14.094

*** p<.01, ** p<.05, * p<.1

Table 4 shows that the post-COVID dummy variable was not significant (p = 0.374) and suggests that there was no instantaneous structural change in free zone non-oil employment as a result of COVID. Time_post_covid is significant and negative (coef. -0.077, p < 0.05), showing that employment decreased over time in the post-COVID period. Good model fit was evident (R^2 = 0.962). The linear regression model examines the determinants of the log of UAE free zone non-oil employment with particular focus on the impact of the COVID-19 pandemic and its effects. Time Variable (Coef. = -0.129, p < 0.01). The time variable is highly significant (*** p < 0.01) and negatively associated with free zone non-oil employment. This reflects a dramatic structural decline in employment across the years, with each year accounted for by a decline of 12.9% in the logarithm of employment. This coefficient suggests that even before the pandemic, the free zone non-oil employment sector was under pressure and was already suffering from structural challenges such as sagging global demand or shifting trends in investment.

Post-COVID Effect (Coef. = 0.152, p = 0.374). The post_covid dummy variable is not statistically significant but still significant, with a p-value of 0.374. This means the initial shock of the COVID-19 pandemic on free zone non-oil employment was insignificant; there had been no sudden structural break

at the point of intervention. Employment levels were not significantly influenced in the short run by emergency action or early market responses. Interaction Term (time_post_covid: Coef. = -0.077, $p < 0.05$)

The correlation between post-COVID and time is negative and statistically significant (** $p < 0.05$), which means that after the COVID-19 outbreak, the fall in free zone non-oil employment increased by 7.7% for each unit of time.. This suggests that the pandemic left a lasting adverse effect, accelerating a previously downward trend.

Constant (Coef. = 9.949, $p < 0.01$) The constant is highly significant and captures the base level of free zone non-oil employment in logarithmic form with all other variables held at zero. The model explains 96.2% of the variation in free zone non-oil employment ($R^2 = 0.962$), demonstrating an excellent fit. The F-test ($F = 199.465$, $p < 0.001$) confirms the statistical significance of the model overall. The model confirms that the non-oil employment sector within UAE free zones has been declining significantly and persistently over time to a significant extent regardless of the COVID-19 pandemic itself. The sheer pandemic impact was not strong enough to alter the significance, implying there was no structural shock at the intended shock point. However, there was an acute deterioration of the decline post-COVID. It is likely that the indirect pandemic impact (i.e. business closures, a general decline in FDI) contributed to the underlying structural decline. These results indicate that policy efforts must be more than merely short-term stimulus policies, and policymakers must find ways to incentivise economic diversification and businesses as well as improve the structure of the UAE's free zone labor market.

Table 5
Impact on Free Zone Imports (lnFreezoneImports)

lFreezoneImports	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.044	.006	-7.62	0	-.058	-.031	***
post_covid	.56	.063	8.86	0	.417	.704	***
time_post_covid	-.208	.014	-14.73	0	-.24	-.176	***
Constant	11.666	.048	241.81	0	11.556	11.775	***

Mean dep. var	11.367	SD dep. var	0.252
R-squared	0.966	Number of obs	13
F-test	160.059	Prob > F	0.000
Akaike crit. (AIC)	-35.896	Bayesian crit. (BIC)	-33.636

*** p<.01, ** p<.05, * p<.1

Table 5 shows the Post-COVID effect as large and positive, with a coefficient of 0.56 ($p < 0.01$), reflecting an immediate surge in free zone imports following the pandemic. However, the interaction term time_post_covid is large and negative, with a coefficient of -0.208 ($p < 0.01$), which reflects that the positive post-COVID effect was short-lived. The goodness of fit for this model is very high, as $R^2 = 0.966$. Using a linear model, this study assesses the drivers of the logarithm of UAE free zone imports. Greater attention will be paid to the COVID-19 pandemic and its impact. Time Variable (Coef. = -0.044, $p < 0.01$). The time variable is very significant at (***) $p < 0.01$ and negatively associated with free zone imports. Each increase in the time period is positively associated with a decline of 4.4% in the logarithm of the free zone import, representing an ongoing structural decline over time pre-COVID. Post-COVID Effect (Coef. = 0.56, $p < 0.01$). The post_covid dummy is highly significant at *** $p < 0.01$ and thus has a coefficient of 0.56. This indicates that in the immediate beginning of the pandemic, free zone imports surged by approximately 56% in log terms above the benchmark in the pre-COVID period. This could be likely a reflection of spontaneous demand for health-related goods and medicine products or even just a temporary relaxation of regulations in the early stages of the pandemic. Interaction Term

(time_post_covid: Coef. = -0.208, p < 0.01). The post-COVID period and time interaction term is significantly negative and large in magnitude at *** p < 0.01, indicating that the initial post-COVID boost in imports did not continue. Instead the shock reduced the impact by 20.8 per cent over the whole period after COVID.". The turning point in the trend is clear evidence of reversal from the initially observed surge in imports over time. The important intercept represents the log level of free zone imports, at which all the independent variables are zero. An excellent model fit as the variance in free zone importations explained by the model is 96.6% (R2 = 0.966). Moreover, an F-test statistically validates the overall model significance; the F-statistic is 160.059 and significant at p 0.001, hence confirming that the free zone import trend in the UAE is strong. Free zone importations greatly surged following the pandemic owing to possible emergency responses and failures in global supply chains. After the pandemic's shock, the slight negative impact on free zone imports resulted in regressing after the initial shock. A reduction in imports throughout history pinpoints the ordeals faced in the free zone import business and suggests strategic policy ways to stabilize and improve this sector. Evidence suggests that temporary crisis interventions during the free zone import exception outbreak existed. However, sustainable growth required a particular approach towards managing such structural changes post COVID.

Table 6
Impact on Free Zone Exports (lnFreezoneExports)

lFreezoneExports	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.056	.018	-3.03	.014	-.097	-.014	**
post_covid	.274	.171	1.60	.144	-.114	.661	
time_post_covid	-.093	.03	-3.14	.012	-.16	-.026	**
Constant	11.406	.162	70.34	0	11.039	11.773	***

Mean dep. var	11.030	SD dep. var	0.270
R-squared	0.851	Number of obs	13
F-test	39.575	Prob > F	0.000
Akaike crit. (AIC)	-14.947	Bayesian crit. (BIC)	-12.688

*** p<.01, ** p<.05, * p<.1

Table 6 reveals that the absence of an immediate jump in free zone exports after COVID outbreak was statistically unimportant (p = 0.144). Due to the significant and negative time interaction known as time_post_covid (coef. -0.093, p 0,051), there has been an observed decrease in free zone exports over time during the post-COVID period. A good model fit is attainable with R2 = 0.851. A linear regression analysis is used to determine the explanatory variables of the log of exports in the UAE free zones, incorporating the COVID-19 pandemic and post-pandeMIC effects. The model employs this approach. The time variable (Coef. = -0.056) is of statistical significance. A negative correlation was observed with free zone exports, and the test result was negative. The long-term consequences of this are evident in a decrease of 5.6% in the log of free zone exports each year. This pattern suggests structural problems in the free zone export sector that were not present before the pandemic. The post_covid dummy variable is positive at the statistical level (p = 0.144) but not significant due to the post-COVID Effect (Coef. = 0.274, p= 0.14). However, free zone exports were not surprisingly affected by the sudden outbreak of the COVID-19 pandemic. Although the positive coefficient would likely account for some short-run factors, the evidence is not robust enough to support an immediate structural impact. Time post correction is -0.093, with a p 0.01. The Interaction Terminus (interaction term) is given by Coef. Negative and significant interaction is the term used. A statistical test showed that the pandemic had a lasting impact on the free zone export trend. However, it was significant in both cases. In particular, the post-COVID deterioration was hastened by 9.3% per time unit in comparison to the pre-pandemic period.This means that the pandemic enhanced pre-existing structural problems and never provided a short-term boost.

Constant (Coef. = 11.406, p < 0.01). The constant term is highly significant and reflects the base logarithm of free zone exports when the other variables are zero. The model explains 85.1% of variance in free zone exports (R^2 = 0.851), which reflects an extremely strong and reliable model fit. F-test (F = 39.575, p < 0.001) confirms the significance of the overall regression model. The results concluded through the analysis are as follows for UAE's free zone exports: There is a significant long-run decreasing trend in free zone exports regardless of the COVID-19 pandemic. The post-COVID effect in the short run on free zone exports was positive but insignificant, meaning there was no sudden break when the pandemic began. Most importantly, the post-COVID period significantly increased the decline of free zone exports, and this points to permanent negative structural effects arising from the pandemic. The evidence presented here suggests that policy action needs to address more permanent structural reforms, rather than transient palliatives. All efforts must be directed at enhancing the competitiveness and sustainability of free zone export business, diversification of non-oil export commodities, and improving the investment climate as a way of offsetting the declining trend observed.

Table 7
Impact on Direct Non-oil Exports (lnDirectNonoilExports)

lDirectNonoilExports	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.046	.018	-2.61	.028	-.086	-.006	**
post_covid	.602	.134	4.50	.001	.299	.905	***
time_post_covid	-.106	.025	-4.30	.002	-.162	-.05	***
Constant	11.082	.13	85.24	0	10.787	11.376	***

Mean dep. var	10.861	SD dep. var	0.350
R-squared	0.934	Number of obs	13
F-test	211.088	Prob > F	0.000
Akaike crit. (AIC)	-18.850	Bayesian crit. (BIC)	-16.591

*** p<.01, ** p<.05, * p<.1

The COEF is indicated in Table 7. The time_post_covid, coef. -0.106, is coep. negative and p 0.01. 0.602. After COVID, there was an increase in direct non-oil exports that led to a gradual decline. The R2 of 0.934 indicates a well-fitted model. Interpretation & Results of Direct Non-oil Exports (lNexexports) Regression. This is a linear regression that evaluates the factors affecting the logarithm of UAE direct non-oil exports. Asymmetrical emphasis has been placed on the COVID-19 pandemic based on the disturbance it caused to global imports. Time Variable. Coef = -0.046, p 0.05. This is the most significant time variable. The time variable has a statistically significant negative coefficient. Over time, the decline in direct non-oil exports has been observed at a rate of roughly 4.6% per time unit on log terms. This is indicated by p > 0.05. It shows that the decline is structural over time in direct non-oil exports irrespective of the pandemic. The post_covid dummy video is of great importance.. A positive coefficient of 0.602 is observed with a probability of 0.01 in the sample size. Non-oil exports saw a log-based increase of around 60.2% following the COVID-19 pandemic, which is approximately equivalent to the pre-COVIA level reported.This boom can be due to sudden export of essential goods, shifts in trade policy, or realignments in global supply chain needs due to the pandemic.Interaction Term (time_post_covid: Coef. = -0.106, p < 0.01). The time and post-COVID time interaction term is negative and significant at the *** p < 0.01 level. This suggests that in the long term, the initial post-COVID increase in direct non-oil exports was not sustainable and declined by about 10.6% per time period during the post-COVID period. This reveals a resumption of the pre-COVID trend of decline.Costat (Coef. = 11.082, p < 0.01).The costat is highly significant, presenting the reference logarithm of direct non-oil exports when all other variables are set to zero. The model explains 93.4% of the variance in direct non-oil exports (R^2 = 0.934), indicating an almost perfect model fit. The general meaning of the model is supported by the F-test (F= 211. 088, p-value=0.001). The sharp and strong growth of direct non-oil exports at the beginning of COVID-19 could

be explained by changes in relations of international trade and crisis-policy actions. This increment is short lived in any event since the size of the negative interaction term indicates an irreversible decline over time in the post Covid era. The time-trend variable also reflects an ongoing structural loss of direct non-oil exports, which are signs of the existing vulnerabilities in the sector despite the pandemic. These results highlight the need to keep on the policy initiatives that can diversify the export activities and stabilize the non-oil export markets to prevent the further decline.

Table 8
Impact on Direct Exports (lnDirectExports)

lDirectExports	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.012	.005	-2.47	.036	-.024	-.001	**
post_covid	.51	.123	4.14	.003	.231	.789	***
time_post_covid	-.189	.037	-5.07	.001	-.273	-.105	***
Constant	11.154	.051	219.60	0	11.039	11.268	***

Mean dep. var	11.079	SD dep. var	0.156
R-squared	0.863	Number of obs	13
F-test	12.435	Prob > F	0.001
Akaike crit. (AIC)	-30.351	Bayesian crit. (BIC)	-28.091

*** p<.01, ** p<.05, * p<.1

Table 8 shows that the post-COVID effect is extremely positive (coef. 0.51, $p < 0.01$). Time interaction (time_post_covid) is extremely negative (coef. -0.189, $p < 0.01$). The model has a high variance explained ($R^2 = 0.863$). Analysis of Regression Data for Free Zone Exports (lnFreezoneExports).. This linear model is designed to estimate the factors that determine the logarithm of UAE free zone exports, with a focus on COVID-19. The time variable (Coef. = -0.056, and P0.05) is the only known value. A negative coefficient is observed in the time variable, indicating statistical significance ($P < 0.05$).This implies that, over time, free zone exports have been decreasing at a rate of 5.6% per time period in logarithmic terms. This is an indicator of free zone export business having a structural decline regardless of the COVID-19 pandemic.Post-COVID Effect (Coef. = 0.274, $p = 0.144$).The post_covid dummy variable is positive but insignificant ($p = 0.144$). This shows that the abrupt onset of the pandemic did not lead to a statistically significant short-term variation in free zone exports. Interaction Term (time_post_covid: Coef. = -0.093, $p < 0.05$), the interaction term is significant and negative (** $p < 0.05$), suggesting that in the post-COVID period, free zone exports declined even further by approximately 9.3% for each time unit. It suggests that the pandemic hastened the pre-pandemic downward trend in free zone export activity.Constant (Coef. = 11.406, $p < 0.01$). The constant term is significant and large and provides the intercept log of free zone exports when the independent variables are equal to zero. With a model that provides an accurate representation of the free zone export variance (R2 = 0.851), it is clear that this is adequate. A test for overall model significance is given by F-test (F = 39.575, p 0,001). Overall, there appears to be a statistically significant and negative temporal trend in this sector, which suggests potential long-term structural issues. There was no sudden short-term change in free zone exports as a direct, positive result of COVID-19. However, the post-COVID period caused a significant increase in free zone exports, which was due to the long-term negative effects of the pandemic. It has been suggested that the short-term stimulus should also address structural weaknesses in free zone export production as part of recovery policy to prevent a prolonged slump. The regression results consistently indicate a strong positive impact of the time immediately following COVID on all economic metrics being examined (imports, exports and free zone employment). Almost all models exhibit negative interaction terms (time_post_covid) with significant consequences. Despite the short-term upsurge in trade activity caused by the COVID pandemic, it was not permanent and declined over time. The high values of R-squared for all models (0.851 to 0.966) indicate a well-defined model that is also valid and confirms their validity.

Table 9
Interpretation of Regression Results for Direct Imports (lnDirectImports)

lDirectImports	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	.006	.01	0.55	.595	-.018	.029	
post_covid	.578	.093	6.23	0	.368	.788	***
time_post_covid	-.176	.012	-14.80	0	-.203	-.149	***
Constant	12.038	.092	131.47	0	11.831	12.245	***

Mean dep. var	12.121	SD dep. var	0.130
R-squared	0.859	Number ofobs	13
F-test	308.574	Prob > F	0.000
Akaike crit. (AIC)	-34.578	Bayesian crit. (BIC)	-32.318

*** p<.01, ** p<.05, * p<.1

The current linear regression equation examines the predictors of the logarithm of the direct imports in the United Arab Emirates, specifically the COVID-19 pandemic and its long-term consequences. Time variable (Coef. = 0.006, p = 0.595). The time variable coefficient is positive but not statistically significant (p= 0.595) and means that, before the pandemic, direct imports did not show an apparent trend of time in the traditional significance level. The small positive coefficient also indicates that an annual growth in direct imports over the years is not significant at all. Post-COVID effect (Coef. = 0.578, p < 0.01). However, the post-COVID dummy is very significant (*** p< 0.01) having a positive coefficient of 0.578, direct imports increased by up to 57.8 per cent in log terms compared to the pre-COVID era. This spurt is probably emergency importation of necessities, medical supplies, or a relaxation of temporary trade policy caused by the pandemic. Interaction term (time_post covid: Coef. -176, p <0.01). The interaction term is negative and significant (*** p < 0.01), which means that the initial increase in the post-COVID direct imports could not last. As a result, direct imports fell by some 17.6 per cent period on period in the post-COVID period, indicating a slow reversion to the structural pre-COVID trend. Constant (Coef. = 12.038, p < 0.01). The constant term is very important, and it signifies the level of direct imports at zero levels of all the independent variables in the log form. Direct imports (R 2 = 0.859) are explained by the model (85.9 percent variability). The significance of the model is checked by the F-test (F=308.574, p= 0.001).Direct imports have significantly and statistically significantly increased immediately after the pandemic, which could be due to emergency-level policy responses and changes in the supply chain. The negative interaction in the post-COVID period refers to a momentary boom and thereafter steadily declining values. The unimportance of the time variable leads to the lack of a noticeable tendency in the direct imports prior to the pandemic, which is an exception to the anticipated trend.

Table 10
Interpretation of Regression Results for Direct Exports (lnDirectExports)

lDirectExports	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
time	-.012	.005	-2.47	.036	-.024	-.001	**
post_covid	.51	.123	4.14	.003	.231	.789	***
time_post_covid	-.189	.037	-5.07	.001	-.273	-.105	***
Constant	11.154	.051	219.60	0	11.039	11.268	***

Mean dep. var	11.079	SD dep. var	0.156
R-squared	0.863	Number of obs	13
F-test	12.435	Prob > F	0.001
Akaike crit. (AIC)	-30.351	Bayesian crit. (BIC)	-28.091

*** p<.01, ** p<.05, * p<.1

The determinants of the logarithm of direct export volumes in the United Arab Emirates (UAE) were analyzed using a linear regression model and the effect of COVID-19 determined, providing an average time variable with a negative statistically significant coefficient (Coef. 0, P 0.05). The analysis showed that the direct exports had a structural decline in that the mean change in the logarithmic measure of the series at the period of observation was 1.2 -, and thus, supported the downward trend. The post COVID dummy variable (post_covid) had a highly significant positive coefficient (Coef. = 0.51, p =<0.01) meaning that direct exports increased by the approximate 51 per cent increment in the log terms directly after the outbreak of the pandemic, which could be explained by updated policy regimes, demand being driven towards medical or essential products, or by changes in the global demand patterns. The interaction term that represents the sign of the joint significance of the time and the post-COVID period (time_post_covid) was found to be significant and negative (Coef. = -0.189, p 0.01) and this indicated that, in the post-COVID era, the growth rate of direct exports slowed by about 18.9 per cent with every time which is not enduring and this shows the transient effect of the pandemic. The constant (Coef.= 11.154, p= < 0.01) is very substantial and indicates the natural logarithm of direct export volumes, when all covariates take the value of zero. The model explains 86.3 percent of changes in direct export volumes (R 2 = 0.863) which again highlights its huge explanatory capacity. The statistical significance of the overall specification of regression is proven by using an F-test (F 12.435, p 0.001). The findings reveal that there is a large, immediate spike in direct exports during the beginning of the pandemic, which reflects a short-term market or policy reaction. The favorable post-COVID effect was only temporary; the negative interaction term represents how the direct exports continued to diminish during the post-pandemic phases. In addition, the time variable in itself is an indication of a negative trend in the direct export volumes that exist beforehand. The results of these findings suggest that although temporary initiatives of emergency measures boosted direct exports, long-term policy interventions are necessary to prevent the structural deterioration and facilitate long-term growth of exports in the UAE. The analysis will be based on annual observations between 2011 and 2023 a comparably short 13-year period, which limits the ability to identify long-run structural changes or slow trends. The model fails to directly include exogenous factors of trade, including global economic cycles, oil price fluctuations, trade policy reforms, or geopolitical tensions, which restricts the ability to cause. The absence of untreated control series prevents an unambiguous separation of the effects of the pandemic and other confounding factors of the time. The binary coding of the post-COVID indicator assumes an equal contemporaneous effect beginning in 2020, which may simplify things like the effect that is graduated or lagged. Regardless of using strong standard errors, there is still a residual risk of time-series non-stationarity undermining the validity of the results in the case where full diagnostic testing has not been done. The impact of COVID-19 on the free-zone trade and employment of the UAE was evaluated using an interrupted time-series analysis. Regularly, the outcomes show that there is a strong temporary increase in trade activities, especially the imports and exports, which are probably caused by the emergency policy actions and the changes in the international demand.

Limitation

The results can't be applied everywhere because the UAE has unique logistics systems, free zone and direct policies.

Conclusion

The current research establishes a clear and measurable impact of COVID-19 on trade relations of UAE, especially in the framework of direct and free-zone businesses. According to empirical data, a significant and immediate increase was seen in imports and exports since the pandemic began. UAE trade and export activity has experienced dynamic changes over the years, which shows the change in world

economic conditions, local policies, and trade policies. This variability highlights why it is critical to carefully model such indicators in order to understand how they relate to each other and predict future trends in the economic environment of the UAE. On the other hand, the free zone played a stabilization role by giving companies the much-needed agility and administrative expediency under crisis situations. However, the long-run decrease in trade volumes and employment highlights the insufficiency of the short-term policy support and suggests the necessity of the structural change. A policy must focus on consolidation of non-oil sectors, and adoption of advanced technologies of both onshore and free-zone businesses. On the whole, the experience gained in this crisis shows that emergency measures can soften short-term threats; however, economic sustainability in the long term requires significant, very conscious, and profound changes in trade patterns.

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