International Journal of Management and Sustainability
2026 Vol. 15, No. 3, pp. 600-616
ISSN(e): 2306-0662
ISSN(p): 2306-9856
DOI: 10.18488/11.v15i3.5159

Post-COVID-19 structure of international trade and its impact on sustainable development in Arab countries

Ziad Abu-Lila[1+]
Abdulluh Ghazo[2]
Sameh Ajlouni[3]

[1,2]*Department of Economics of Finance and Business, School of Business, Al al-BAYT University, Mafraq, Jordan.*
[1]*Email: Abu-lila@aabu.edu.jo*
[2]*Email: aghazo@aabu.edu.jo*
[3]*Department of Economics, Faculty of Business, Yarmouk University, Irbid, Jordan.*
[3]*Email: ajlouni.sameh@yu.edu.jo*

(+ Corresponding author)

Article History
Received: 19 May 2026
Revised: 9 July 2026
Accepted: 30 July 2026
Published: 8 September 2026

Keywords
Arab countries
COVID-19
Fixed-effects panel EGLS
International trade
Sustainable development.

ABSTRACT

The purpose of this study is to analyze the effects of post-COVID-19 structure of international trade on multiple aspects of sustainable development in selected Arab countries (Jordan, Saudi Arabia, United Arab Emirates, Qatar, Morocco, Egypt, Kuwait and Tunisia) over the period 2014-2024. To achieve the purpose of the study, we employed the fixed-effects panel EGLS and the dummy interaction approach to estimate some equations where it used GDP pair capita, unemployment rate and CO_2 emissions as indicators of the economic, social and environmental aspects of sustainable development. The results showed that post the pandemic, trade in manufactured products had positive impact on GDP per capita and deteriorating positive impact on unemployment, while the impact on CO_2 emissions has reversed and became negative. On another front, post the pandemic, trade in fuels and mining products had slightly promoted its positive impact on GDP per capita, but no statistically significant impacts on unemployment or CO_2 emissions were observed. Concerning trade in agricultural products, the negative impact of GDP per capita has declined post the pandemic, lost its statistical significance on unemployment, and had negative impact on CO_2 emissions. To boost socio-economic and environmental gains of international trade in Arab countries, the study recommends restructuring exports towards high value-added products and focusing more on agricultural manufacturing to increase its share of the GDP and to create sustainable job opportunities, as well as promoting investment in green sectors to foster the path of sustainable development.

Contribution/Originality: This study contributes to bridging a knowledge gap on the post-COVID-19 structure of international trade by analyzing how these structural transformations affect sustainable development pathways in Arab countries and providing insights that support policymakers in enhancing economic resilience and advancing sustainability.

1. INTRODUCTION

Recently, the world has undergone accelerated socioeconomic and technological transformations that have reshaped international trade to improve the welfare of individuals and societies. However, the 2020 pandemic marked a critical turning point for trade and supply chains. Lockdowns, quarantines and movement restrictions caused unprecedented turmoil in the flow of goods and services a sharp decline in international trade volume and substantial shifts in local and global consumption patterns. These developments forced countries, companies and communities to reassess the structure of international trade to mitigate the pandemic's repercussions and to prepare for potential future crises.

Post-pandemic changes in the structure of international trade are direct reflections of the changes the world has witnessed. Chilicaus et al. (2025) contended that countries rushed into digital transformation, increased reliance on e-commerce, and restructured supply chains to ensure resilience and to reduce dependence on traditional resources. Mohsin et al. (2024) noted that many countries are experiencing increased investments directed towards green sectors, increased interest in the concepts of circular and green economies and reducing CO_2 emissions in production chains and transportation. In many countries, new trade policies were designed to take into account environmental and social dimensions in trade agreements, indicating a gradual transformation towards more sustainable and responsible trade, enforcing linkages between international trade and sustainable development (Zi, Pan, & Wang, 2026).

Ranjbari et al. (2021) indicated that the COVID-19 pandemic has exposed the low response of economic systems to emergent shocks, thus strengthening global dialogue around the importance of striking a balance between economic growth and socio-environmental sustainability. Most importantly, sustainable development is no longer a complementary choice, but rather a fundamental condition for achieving long-run economic stability and social well-being.

Given its role in creating jobs, promoting innovation and transferring knowledge and technology, international trade has become a cornerstone in boosting socio-economic and environmental development. However, the change in the structure of international trade post the pandemic poses concerns about its compliance with the Sustainable Development Goals (SDGs) that were adopted by the United Nations for the 2030 Agenda, especially the ones related to consumption and production, decent work and economic development, and equality among countries.

Despite its key role in fostering sustainable development requirements, international trade faces several challenges, including weak digital infrastructure in many countries, variances in production and technological capabilities and inequitable distribution of trade gains. Moreover, the increased reliance on e-commerce has raised new concerns about energy consumption, electronic wastes and changes in consumption patterns, which requires the adoption of integrated policies to create a balance between economic innovation and environmental protection (Sarkar, 2023).

Arab countries were not isolated from the rest of the world; Arab international trade experienced notable changes after the pandemic due to global economic shifts and unstable supply chains. Lockdowns and quarantines caused a temporary decline in the volume of Arab international trade. However, as markets recovered, Arab countries began restructuring trade relations and diversifying partners. The crisis also accelerated digital transformation across Arab countries and promoted technology adoption in logistics and supply chains (ESCWA, 2022). Gulf Arab states benefited from higher energy prices, increasing oil revenues and investing more in non-oil sectors, while non-oil Arab countries took steps to boost exports of agricultural and manufactured goods to attract more hard currency.

The above discussion emphasizes the significance of our study in measuring and analyzing the post-pandemic impact of the structure of international trade in the Arab countries, through observing the transformations that occurred to the Arab trade activity and exploring the extent of its compliance with the principles and goals of socio-economic and environmental sustainability.

Sustainability is an integrated concept that balances economic growth, environmental protection and social justice; therefore, hinging solely on economic analysis to understand the impact of changes in the structure of international trade on sustainable development is not sufficient by itself; rather, social and environmental analyses are also necessary. Therefore, this study is an opportunity to compare the impact of changes in international trade on the three dimensions of sustainable development pre- and post-pandemic.

The study also offers an opportunity to evaluate the trends of Arab trade, that helps in providing recommendations that might contribute to establishing an Arab trade system which is more resilient, fair and sustainable, and can overcome future crises as well as accomplishing the aspiration of future generations. This idea has shaped both our research problem and research question that the study seeks to answer. In particular, the study wants to answer the following question: do changes in the structure of international trade post the pandemic reinforce the SDGs in the Arab countries?

Finally, the study consists of six sections. Section 1 provides an introduction to the study, describing the research problem and its importance. Section 2 reviews the theoretical background and relevant literature. Section 3 briefly describes the status of international trade post-COVID-19. Section 4 contains a description of the data and data analysis methodology. Section 5 presents the econometric analysis. Lastly, section 6 summarizes the study's findings and offers recommendations.

2. THEORETICAL FRAMEWORK AND LITERATURE

Many economists highlighted the importance of international trade in promoting economic growth and development, through the transfer of technology, machinery and capital, as well as product diversification (Vijayasri, 2013). The impact of international trade is not dependent on its volume only but also relates to what countries export and import (the structure of international trade). The structure of international trade indicates the product composition of exports and imports, including the types of exported and imported goods and their relative weights in trade exchange.

The structure of trade measures the composition of international trade in addition to what is exchanged internationally (goods and services produced from various sectors), which in turn depends on the degree of production specialization for each country along with the available resources. The diversity of the structure of international trade plays a crucial role in promoting economic growth and reducing the impact of market fluctuations on exports revenues (International Monetary Fund, 2018). Moreover, the diversification of exports and imports and decreased concentration in specific groups of products shall reduce the impact of increased and decreased global demand for international trade revenues.

The structure of international trade is not merely a measure of the volume of exchange, but rather an analysis of the quality and components of this exchange, and how these components change over time as a result of changes in the factors that determine the volume and composition of international trade.

Many economic theories and applied research have documented these factors. Starting from the classical models of international trade theory- such as the Ricardian and the Heckscher-Ohlin-Samuelson models-suggest that differences in relative costs of production among countries determine the patterns of international trade. New international trade theories that emerged in the late 1980s advocate that international trade takes place among similar countries. According to these theories, economies of scale, imperfect competition and technological gaps are the key determinants of international trade. Others argue that variations in trade costs can be explained by geographical location and factor of production mobility (Krugman & Venables, 1995).

According to the gravity models that were developed later, trade between two countries is inversely related to their geographical distance and directly related to their size, as well as any other factors that might reduce international trade costs, such as the existence of common borders, a common language, preferential tariffs, and signed trade agreements (Eaton & Kortum, 2002). Recent literature has focused on new sources of comparative advantage that arise from the interaction of policies and regulatory frameworks with the needs of specific sectors of the economy (Helpman, 2010).

Riaz, Siddique, Audi, and Sumaira (2024) highlighted the role of financial development and increased access to capital markets in supporting firms and promoting exports in southern Asian countries. Cuñat and Melitz (2012) indicated that flexible labor market policies promote exports in industries with fluctuated demand. In line with that, the structure of international trade is influenced by socio-economic and political factors; health factors, such as the COVID-19 pandemic, might influence the structure of international trade as.

In late 2019, the breakout of coronavirus (COVID-19) started. The virus originally emerged from Wuhan, China for the first time. In 2020, the World Health Organization declared COVID-19 a global pandemic. The number of infected people reached its peak in 2021. In 2023, the number of infections and deaths started declining because of compliance with preventive measures and the development of vaccines.

The breakout of corona virus, accompanied with the lockouts have impacted employment, production and trade, Hayakawa and Mukunoki (2021) documented the negative impacts of the pandemic on both exporters and importers; however these effects started declining in the importer countries. The study showed that the pandemic's impact was not equal across different sectors; for example, the negative impact has long lasted on non-essential and durable goods, whereas health-related industries have benefited from the pandemic. Choroś-Mrozowska (2022) noted that the pandemic has contributed to a change in the geographical structure of international trade.

Barbero, de Lucio, and Rodríguez-Crespo (2021) contend that the negative impact of COVID-19 was more profound on the countries that had bilateral regional trade agreements pre-pandemic. The study also concluded that the pandemic has large impact on the exports of high-income countries.

Meinen, Serafini, and Papagalli (2025) indicated that the dispersion in the economic impact of the pandemic related to the governmental containment measures and the structures of the economic sectors in countries, in addition to the trade relations and economic structure of the region as well as the integration of the supply chains.

The interest in international trade and the factors that influence it stems from the key role it plays in promoting economic growth, as well as achieving SDGs at various socio-economic and environmental levels. As noted by Riekhof, Regnier, and Quaas (2019), this can be done through resource allocation, facilitating technological transfer and raising productive efficiency. International trade can help in creating job opportunities, increasing income, and alleviating poverty levels, which are key SDGs. In addition to that, trade relations promote the global spread of green technologies and eco-friendly products (Cao & Wang, 2017), which help countries, particularly developing countries, accessing new technologies as well as fostering sustainable development paths (Chen, Sun, Xu, & Xu, 2025).

On the other hand, some studies have indicated that there are negative impacts of international trade on sustainable development. Belloumi and Alshehry (2020) found a negative relationship between trade openness and two indicators of sustainable development, i.e., economic growth and environmental quality. Ghose (2004) indicated that the benefits of international trade are not equally distributed among developed and developing countries because the exports of developing countries have relatively low value added.

Razak, Saudi, Fernandes, Idris, and Rahman (2025) found that an increase in trade activities exacerbates environmental degradation and jeopardizes the SDGs in the ASEAN region in the long run. Therefore, policymakers are required to incorporate trade policies with comprehensive environmental regulations to ensure consistent economic integration with the principles of sustainability and equity among generations.

Among the studies that documented negative impacts of international trade on the SDGs is the one by Adao, Carrillo, Costinot, Donaldson, and Pomeranz (2020); they found that international trade increases wage inequality. Arce, López, and Guan (2016) and Ssekibaala, Ariffin, and Duasa (2022) analyzed the impact of international trade on increasing environmental pollution. (Steen-Olsen, Weinzettel, Cranston, Ercin, & Hertwich, 2012) emphasized the impact of international trade in increasing consumption.

Therefore, it is essential that trade exchange being able to foster economic growth and be socially and environmentally sustainable, so that it benefits the whole society. This requires providing support through well-designed policies and global partnerships under an international trade system which is rule-based, open, non-discriminatory and fair to achieve sustainable development (UNCTAD, 2026).

The bottom line is that the impacts of international trade on sustainable development could be positive or negative. In addition, the ability of international trade to achieve sustainable development depends on the volume and the structure of international trade, which in turn are influenced by several factors, including health factors.

In light of the preceding review, some limitations and gaps in the existing literature may be identified, including.

1. Previous studies can generally be classified into two main streams. The first stream examined the impact of the COVID-19 pandemic on international trade and its associated economic repercussions. The second stream focused on analyzing the influence of international trade on some dimensions of sustainable development.
2. Existing research largely focused on global or developed economies, while limited attention has been given to Arab countries despite their structural trade vulnerabilities after COVID-19.
3. Many post-pandemic studies analyzed trade disruptions and recovery separately, without investigating how changes in trade structure influence sustainable development outcomes.
4. There remains insufficient empirical evidence on the post-COVID transformation of trade structures in Arab economies and its implications for sustainable development indicators.

Accordingly, this study contributes to the existing literature by examining the impact of post-COVID trade structure changes on sustainable development in Arab countries, thereby addressing an important regional and empirical gap in the literature.

3. INTERNATIONAL TRADE POST THE PANDEMIC

Figure 1 displays the evolution of global international trade over the period 2014-2024, measured in millions of US dollars. The impacts of global shocks are clearly evident. In 2020, the volume of international trade declined by nearly 9% compared to 2019 due to the repercussions of the COVID-19 pandemic and the accompanying restrictions on international transport, disruption of supply chains, and decline in global demand.

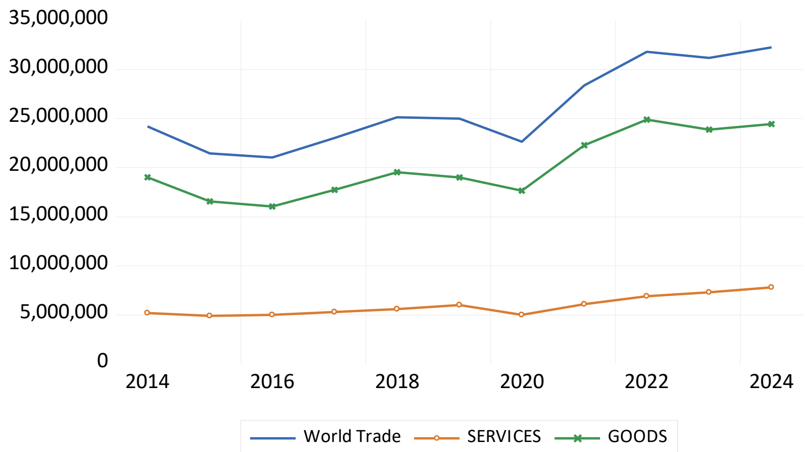

Figure 1. Evolution of International Trade.

As the global economy began to recover and health restrictions eased, international trade rebounded, growing by 25% in 2021 and 12% in 2022. However, international trade declined again in 2023 due to rising inflation and interest rates, and a reorientation of consumption following the pandemic (OECD, 2024).

Sectoral analysis indicates that the decline in services trade was more severe, reaching 17% compared to a 7% decrease in trade in goods in 2020. This can be explained by the nature of services, which rely more heavily on the movement of people, travel, and tourism—sectors most affected by precautionary measures. Following the pandemic, the goods sector recovered more quickly, growing by 26% in 2021 compared to 22% for trade in services. This suggests that the goods sector's recovery was relatively faster, driven by the resumption of activity in the industrial sector and increased demand for basic and capital goods. In contrast, the services sector's recovery continued at a relatively slower pace, due to the persistence of some restrictions and the sluggish return of activities related to travel, transportation, and personal services.

At the Arab level, data from the World Bank indicates a decline in the contribution of Arab international trade to Arab GDP during the COVID-19 pandemic, reflecting the profound economic impact of the pandemic. The ratio of trade in goods to GDP fell from 66.57% in 2019 to approximately 60.82% in 2020, reflecting a decrease in goods trade activity due to reduced external demand, disruptions to supply chains, and a decline in international transport and trade.

However, Arab trade in services experienced a more pronounced decline; its share of GDP has declined from 17.51% in 2019 to 14.08% in 2020. This downward trend continued in 2021, reaching 13.37%. This sustained decline indicates that the services sector in Arab countries was more severely impacted by the pandemic and slower to recover compared to the goods sector, given its heavy reliance on tourism, transportation, and services related to the movement of people, which continued to suffer from health restrictions and sluggish demand for a longer period.

The impact of the pandemic also varied across different commodity groups. The demand for specific commodity groups such as health supplies and basic foodstuffs has increased. While the demand for other commodity groups such as oil, fuel, and non-essential manufactured goods has declined. As shown in earlier research, the extent of recovery from the impacts of the pandemic has also varied across the economic sectors.

Finally, the following questions arise: does the structure of international trade in Arab countries serve their sustainable development goals? Has the COVID-19 pandemic altered the structure of Arab international trade? Do these changes serve the sustainable development goals of Arab countries? These questions will be answered in the next section by data collected from eight Arab countries: Jordan, Saudi Arabia, Egypt, the United Arab Emirates, Qatar, Kuwait, Morocco, and Tunisia, covering the period 2014-2024, to estimate a set of econometric models.

4. DATA AND METHODOLOGY

4.1. Data

This study aims to measure the post-COVID-19 pandemic impact of changes in the structure of international trade on sustainable development in Arab countries. To achieve this objective, data were collected on eight Arab countries during the period 2014-2024: Jordan, Saudi Arabia, the United Arab Emirates, Egypt, Tunisia, Morocco, Qatar, and Kuwait. These countries were selected because they exemplify geographical, economic, and trade diversity. The sample included countries from the Arabian Gulf, Africa, and the Levant. To ensure economic diversity, the sample comprised oil-producing, service-sector, agricultural, and industrial countries. Most of the selected countries are moving towards trade integration through the signing of trade agreements. Table 1 presents the variables used in the analysis.

Table 1. Definition of the Variables.

Symbol	Variables	Unit of Measurement	Source
GDPC	Gross domestic product per capita	One million US dollars	World Bank
K	Gross capital formation	One million US dollars	World Bank
L	Number of employed	Million	World Bank
TA	Agricultural products trade as a percentage of GDP	$\left(\frac{XA + MA}{GDP}\right)$	World Trade Organization
TM	Manufactured products trade as a percentage of GDP	$\left(\frac{XM + MM}{GDP}\right)$	World Trade Organization
TF	Fuels and mining products trade as a percentage of GDP	$\left(\frac{XF + MF}{GDP}\right)$	World Trade Organization
UR	Unemployment rate	Ratio	World Bank
POP	Population	Million	World Bank
RGDP	Real gross domestic product	One million US dollars and base year is 2015	World Bank
CO2	Carbon dioxide (CO2) emissions	Million tons of CO2 equivalent	World Bank
Energy	Energy use	kg of oil equivalent	World Bank
Dum	Dummy variable	Dum = 1 during (2020-2024) Dum = 0 otherwise	

4.2. Methodology

To evaluate the post-COVID-19 pandemic impact of changes in the structure of international trade on sustainable development indicators in Arab countries, three separate econometric models were developed and estimated. Each model employed one of the dimensions of sustainable development as a dependent variable: the economic, social, and environmental dimensions. The study period spans 2014 to 2024, allowing for pre- and post-pandemic comparison while capturing the effects associated with the restructuring of international trade in the region.

4.2.1. First Model: The Economic Dimension of Sustainable Development

To measure the economic impact of the structure of international trade on sustainable development in Arab countries, an econometric model was developed and estimated, using GDP per capita as the dependent variable. GDP per capita serves as an indicator reflecting the expected effects of international trade on the level of economic welfare and resource allocation efficiency within a country. Ahmadi, Rabin, and Qadamshahi (2025) and Tandra et al. (2025) have used GDP per capita as an economic indicator of sustainable development in their research. The first model is specified as follows:

$$GDPC_{it} = f(K_{it}, L_{it}, TM_{it}, TF_{it}, TA_{it}) \quad (1)$$

Where: i denotes country, and t represents time.

For estimation purposes, the above model is represented as an econometric model in logarithmic form as:

$$Log(GDPC_{it}) = \beta_0 + \beta_1 Log(K_{it}) + \beta_2 Log(L_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \varepsilon_{it} \quad (2)$$

Where: Log stands for the natural logarithm, $\beta_i, i = 1, \ldots, 5$ are the parameters to be estimated, and ε_{it} is the error term.

To capture the interaction effects of post-COVID-19 changes in the structure of international trade on the economic sustainable development indicator, a dummy variable (Dum) was incorporated into the econometric model, as follows:

$$Log(GDPC_{it}) = \beta_0 + \beta_1 Log(K_{it}) + \beta_2 Log(L_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TM_{it}) + \varepsilon_{it} \quad (3)$$

$$Log(GDPC_{it}) = \beta_0 + \beta_1 Log(K_{it}) + \beta_2 Log(L_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TF_{it}) + \varepsilon_{it} \quad (4)$$

$$Log(GDPC_{it}) = \beta_0 + \beta_1 Log(K_{it}) + \beta_2 Log(L_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TA_{it}) + \varepsilon_{it} \quad (5)$$

4.2.2. Second Model: The Social Dimension of Sustainable Development

From a social perspective, the impact of the structure of international trade on sustainable development can be measured by estimating an econometric model that uses the unemployment rate as a dependent variable. This rate is used as an indicator reflecting the social dimensions of development, such as job creation, stability of the local market, and mitigation of social conflicts. This model allows for analysis of the relationship between changes in international trade and the level of social well-being. Following the studies of Awad-Warrad (2018) and Gonese, Sibanda, and Ngonisa (2023), the second model is expressed as:

$$UR_{it} = f(POP_{it}, RGDP_{it}, TM_{it}, TF_{it}, TA_{it}) \quad (6)$$

To estimate the above model, it is expressed as an econometric model in the semi-logarithmic form as:

$$UR_{it} = \beta_0 + \beta_1 Log(POP_{it}) + \beta_2 Log(RGDP_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \varepsilon_{it} \quad (7)$$

To capture the interaction effects of post-COVID-19 changes in the structure of international trade on the social sustainable development indicator, a dummy variable (Dum) was incorporated into the econometric model, as follows:

$$UR_{it} = \beta_0 + \beta_1 Log(POP_{it}) + \beta_2 Log(RGDP_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TM_{it}) + \varepsilon_{it} \quad (8)$$

$$UR_{it} = \beta_0 + \beta_1 Log(POP_{it}) + \beta_2 Log(RGDP_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TF_{it}) + \varepsilon_{it} \quad (9)$$

$$UR_{it} = \beta_0 + \beta_1 Log(POP_{it}) + \beta_2 Log(RGDP_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TA_{it}) + \varepsilon_{it} \quad (10)$$

4.2.3. Third Model: The Environmental Dimension of Sustainable Development

CO2 emissions have been extensively employed in the literature as a dependent variable to measure the impact of the structure of international trade on environmentally sustainable development. (e.g., (Ali & Dhiif, 2025; Goswami et al., 2023)). CO2 emissions reflect the environmental dimension and allows for the assessment of the relationship between changes in international trade and the level of environmental impact. The general form of the third model is expressed as:

$$Co2_{it} = f(Energy_{it}, GDPC_{it}, TM_{it}, TF_{it}, TA_{it}) \quad (11)$$

To estimate the model, it is expressed econometrically in the logarithmic form as:

$$Log(Co2_{it}) = \beta_0 + \beta_1 Log(Energy_{it}) + \beta_2 Log(GDPC_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \varepsilon_{it} \quad (12)$$

To assess the interaction effects of post-COVID-19 changes in the structure of international trade on the environmentally sustainable development indicator, a dummy variable (Dum) was added to the econometric model, as follows:

$$Log(Co2_{it}) = \beta_0 + \beta_1 Log(Energy_{it}) + \beta_2 Log(GDPC_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TM_{it}) + \varepsilon_{it} \quad (13)$$

$$Log(Co2_{it}) = \beta_0 + \beta_1 Log(Energy_{it}) + \beta_2 Log(GDPC_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TF_{it}) + \varepsilon_{it} \quad (14)$$

$$Log(Co2_{it}) = \beta_0 + \beta_1 Log(Energy_{it}) + \beta_2 Log(GDPC_{it}) + \beta_3 Log(TM_{it}) + \beta_4 Log(TF_{it}) + \beta_5 Log(TA_{it}) + \beta_6 Dum \times Log(TA_{it}) + \varepsilon_{it} \quad (15)$$

5. ECONOMETRIC ANALYSIS

To determine the appropriate estimation method(s) for panel data, several econometric tests would be performed a priori. These tests include stationarity, Hausman, Breusch-Pagan, and the redundant fixed effect tests.

5.1. Stationarity Test

A variety of stationarity tests are employed in applied research. Among these, we selected Levin-Lin-Chu (LLC), as it is one of the most widely used tests. Table 2 shows the results of the test.

Table 2. Levin-Lin-Chu (LLC) Stationarity Test.

Variables	Statistics value at level	Probability	Lags
Log(GDPC)	-6.4	0.00*	0 to 1
Log(K)	-6.26	0.00*	0 to 1
Log(L)	-2.45	0.01*	0 to 1
Log(TA)	-8.74	0.00*	0 to 1
Log(TM)	-7.95	0.00*	0 to 1
Log(TF)	-9.97	0.00*	0 to 1
UR	-4.5	0.00*	0 to 1
Log(POP)	-11.96	0.00*	0 to 1
Log(RGDP)	-5.04	0.00*	0 to 1
Log(CO2)	-2.37	0.01*	0 to 1
Log(Energy)	-8.08	0.00*	0 to 1

Note: * Denotes stationarity at the 1% significance level.

As shown in Table 2, all variables are stationary in levels. To address autocorrelation, the optimal lag length was determined using the minimum value of the Akaike Information Criterion (AIC). For panel data, there are three estimation methods suitable for stationary data in levels: pooled data, fixed effects, and random effects methods. Method selection was guided by econometric tests, including the Hausman test, the Breusch-Pagan test, and the redundant fixed-effects test.

5.2. First Model: The Economic Dimension of Sustainable Development Measured by GDP Per Capita

The first model has identified the variables that would be employed to measure the impact of the structure of international trade on the economic sustainable development index, represented by GDP per capita. Next, the study estimated this model using the three methods designed for panel data, followed by the necessary preliminary tests to determine the most appropriate model, pooled, fixed effects or random effects. Table 3 presents the results of these tests.

Table 3. Model Selection Test Results for the Economic Dimension Model.

Test	Statistics	Prob.
Breusch Pagan	63.39*	0.00
Hausman	56.56*	0.00
Redundant Fixed effect test	68.66*	0.00

Note: * Indicates statistical significance at the 1% level.

Based on the results in Table 3, the null hypothesis of "no random individual effects" has been rejected based on the value of the test statistic of the Breusch-Pagan test, which means that the random effect model is preferred over the pooled data model. The results of the redundant fixed effects test indicate that the fixed effects model is preferred over the pooled data model, because the p-value of the test statistic is below the 5% significance level (Baltagi, 2008).

Finally, the Hausman test rejected the hypothesis of no correlation between individual effects and explanatory variables, meaning that the fixed-effects model is the appropriate model for estimating Equation 1 (Baltagi, 2008). It is also worth noting that these tests were conducted on all Equations 3–5 of the first model, all of which indicated that the fixed-effects method is the most appropriate. The fixed-effects method in all equations was estimated using the Panel EGLS technique to ensure that the estimated equation is free from the problems of autocorrelation and heteroscedasticity (Greene, 2012). The estimation results of Equations 3–5 are displayed in Table 4.

Table 4. The dependent variable is Log (GDPC).

Variables	Equation 2	Equation 3	Equation 4	Equation 5
Constant	8.46 [0.551] (15.36)*	9.16 [0.496] (18.46)*	8.53 [0.517] (16.5)*	9.19 [0.579] (15.87)*
Log(K)	0.2 [0.061] (3.28)*	0.11 [0.055] (1.99)**	0.19 [0.054] (3.55)*	0.11 [0.062] (1.77)***
Log(L)	0.08 [0.121] (0.66)	0.11 [0.229] (0.48)	0.2 [0.225] (0.89)	0.09 [0.164] (0.55)
Log(TM)	-0.35 [0.127] (-2.75)*	0.03 [0.2] (0.15)	-0.09 [0.18] (-0.5)	0.03 [0.188] (0.16)
Log(TF)	0.17 [0.032] (5.32)*	0.15 [0.051] (2.95)*	0.15 [0.049] (3.04)*	0.16 [0.04] (4.03)*
Log(TA)	-0.33 [0.121] (-2.72)*	-0.71 [0.186] (-3.81)*	-0.56 [0.173] (-3.23)*	-0.34 [0.076] (-4.49)*

Variables	Equation 2	Equation 3	Equation 4	Equation 5
Dum* Log(TM)		0.04 [0.013] (3.1)*		
Dum* Log(TF)			0.03 [0.013] (2.25)**	
Dum* Log(TA)				0.07 [0.014] (5.19)*

Note: *, ** and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
The standard error in [ ], and calculated t-values in ( ).

Equation 2 in Table 4 presents the estimation results of Equation 2 prior to the inclusion of the dummy variable designed to capture the interaction effect of the COVID-19 pandemic. The results show that capital had a statistically significant positive impact on GDP per capita. However, labor had a positive impact, though it is unexpectedly not statistically significant. This might be explained by several factors. It might be that growth in the sample of Arab countries under investigation is driven by factors other than labor, including technology, oil exports, and investments. Another possible explanation could be the diminishing marginal productivity of labor or the presence of disguised unemployment, particularly in the public sector. Moreover, since the dependent variable is calculated by dividing total production by population, if the increment in labor is identical to the increment in population, the impact of labor on the dependent variable will be reduced.

However, with respect to international trade variables, the effect of trade in manufactured products on GDP per capita was unexpectedly negative, though statistically significant. This might be explained by the fact that the volume of imports of Arab manufactured goods exceeds the volume of exports, leading to a chronic deficit in the Arab manufacturing trade balance. This, in turn, results in leakages of hard currency abroad, creating pressure on local currency and thereby reducing the positive impact of trade in manufactured goods in the long run. Additionally, the local value added for manufactured exports is low because they are not technologically intensive and are highly dependent on imported factors of production.

On the other hand, the trade in fuels and mining products had a positive impact on GDP per capita due to the high productivity of this sector in most of the countries in the sample. Moreover, high revenues yielded from the exports of oil and gas promote investment in infrastructure and secure necessary funding to purchase factors of production for other sectors, contributing to sustainable growth in GDP per capita.

The results of Equation 2 showed a statistically significant negative impact of trade in agricultural products on GDP per capita. The negative impact can be explained by the fact that agricultural exports are primary products with low added value and productivity and are more susceptible to price fluctuations and climate conditions. Furthermore, since demand for these products is inelastic, this means that decreasing prices would lower revenues obtained from these exports, thus reducing their role in achieving sustainable growth in GDP per capita.

The interaction effect of the Coronavirus pandemic on the structure of international trade is shown in equations 3 to 5. Equation 3 shows a statistically significant positive impact of trade in manufactured goods on GDP per capita post the pandemic. Specifically, the interaction coefficient of the dummy variable multiplied by the trade in manufactured goods variable is 0.04. This means that a 1% increase in trade in manufactured goods leads to a 0.04% increase in per capita GDP in the years following the Coronavirus pandemic. Equation 3 also indicates that the manufactured goods trade coefficient Log (TM) becomes statistically not significant after adding the dummy variable to the equation.

The positive impact of trade in manufactured goods on GDP per capita after the pandemic can be attributed to changes in supply chains and increased reliance on regional trade, as well as the revitalization of domestic industries to compensate for import disruptions and the increased degree of substitutability. Furthermore, the surge in fuels revenues has promoted specific domestic industries, particularly those related to medical, chemical, and food products.

Finally, the COVID-19 pandemic led to the exit of low-productive and inefficient domestic industries, thus boosting the positive effect of trade in manufactured goods on GDP per capita.

Equation 4 shows the interaction effect of the change in trade in fuel and mining products on GDP per capita post the pandemic. A slight increase in the positive effect of fuel and mining commodity trade on GDP per capita was observed. The coefficient of this type of trade increased from 0.17 in Equation 2 to 0.18 (0.15+0.03=0.18) in Equation No. (4).

Finally, the results of Equation 5 show that the interaction effect of the dummy variable with the trade in agricultural products variable was positive, which indicates a decrease in the net negative effect of trade in agricultural products on GDP per capita after the Corona pandemic from -0.33 to -0.27. This is explained by the tendency of the countries to rely more on local production and to increase food stocks as a precaution measure for any possible future disruptions in supply chains, or significant price hikes, especially for grains and basic food commodities.

The results summarized in Table 4 indicate that international trade in the post-COVID-19 period has served the sustainable development Index related to the economic dimension, as the interaction effect between trade in different commodity groups and GDP per capita was positive and statistically significant after the pandemic.

5.3. Second Model: The Social Dimension of Sustainable Development Measured by Unemployment Rate

Model (6) aims to use the unemployment rate as a social indicator of sustainable development. To determine the most appropriate estimation method among pooled, fixed effects, and random effects models, the required pre-estimation tests were performed, as reported in the following table.

Table 5. Model Selection Test Results for the Social Dimension Model.

Test	Statistics	Prob.
Breusch Pagan	186.49*	0.00
Hausman	12.13**	0.03
Redundant fixed-effect test	34.65*	0.00

Note: * and ** indicate statistical significance at the 1% and 5% levels, respectively.

The results shown in Table 5 confirm that the fixed-effects model is the appropriate model for estimating the unemployment equation, also the results of these tests were conducted on all Equations 8–10 of the second model, all of which indicated that the fixed-effects model is the most appropriate. The estimation results are presented in the following Table 6.

Table 6. The dependent variable is "UR".

Variables	Equation 7	Equation 8	Equation 9	Equation 10
Constant	46.15 [2.972] (15.53)*	46.41 [4.032] (11.51)*	45.28 [3.58] (12.65)*	46.11 [4.045] (11.4)*
Log(POP)	2.09 [0.668] (3.13)*	1.71 [0.713] (2.4)**	1.82 [0.7] (2.6)*	2.00 [0.741] (2.7)*
Log(RGDP)	-3.54 [0.432] (-8.2)*	-3.32 [0.571] (-5.82)*	-3.36 [0.541] (-6.21)*	-3.5 [0.587] (-5.96)*
Log(TM)	1.97 [0.694] (2.84)**	0.75 [0.721] (1.04)	1.61 [0.719] (2.24)**	1.67 [0.711] (2.35)*
Log(TF)	-2.65 [0.666] (-3.98)*	-3.11 [0.912] (-3.41)*	-3.07 [0.945] (-3.25)*	-2.63 [0.95] (-2.77)*
Log(TA)	-0.21	0.18	0.42	0.06

Variables	Equation 7	Equation 8	Equation 9	Equation 10
	[0.84] (-0.25)	[0.947] (0.19)	[0.894] (0.47)	[1.00] (0.06)
Dum* Log(TM)		1.89 [0.815] (2.32)*		
Dum* Log(TF)			0.55 [0.437] (1.26)	
Dum* Log(TA)				0.45 [0.592] (0.76)

Note: *, and ** indicate statistical significance at the 1%, and 5% levels, respectively.
The standard error in [ ], and calculated t-values in ( ).

As shown in Equation 7, the key variables of the unemployment function had the expected signs and were statistically significant. Specifically, population size had a statistically significant positive effect on unemployment, meaning that an increase in population size leads to an increase in the unemployment rate. Conversely, real GDP had a negative effect on unemployment. These results are consistent with economic theory.

The results of the structure of international trade indicate a statistically significant positive effect of trade in manufactured goods on the unemployment rate. This might be explained by the fact that in Arab countries, the volume of imports of manufactured goods exceeds the volume of exports. A similar explanation was presented for the equation of GDP per capita. The results of Equation 7 revealed a statistically significant negative impact of trade in fuel and mining products on the unemployment rate. This is explained by the high productivity of this sector in most of the countries in the sample, which generates substantial financial returns that aid in creating jobs and reducing unemployment rates. In contrast, the impact of trade in agricultural products on unemployment was not statistically significant. The results of Equation 8 indicate that including a dummy variable that captures the interaction effect of changes in trade in manufactured products on the unemployment rate reduced the positive impact of this trade on unemployment from 1.97 to 1.89. This is a result of the tendency towards relying on regional trade and promoting local products, as was previously explained in the equation of GDP per capita. The results of Equation 9 and Equation 10 show that the dummy variables measuring the interaction effect of the COVID-19 pandemic with trade in fuel, mining, and agricultural products were statistically not significant. This means that changes in trade in these products after the pandemic did not have a clear impact on unemployment rates in Arab countries. This may be due to the nature of these two sectors, which require a long period for their impact on unemployment to become apparent. The results of Table 6 show that trade in manufactured products after the Corona pandemic served the social dimension of the sustainable development index. However, no statistical significance was observed on unemployment rates as a result of the change in the trade of fuel, mining and agricultural products after the pandemic.

5.4. Third Model: The Environmental Dimension of Sustainable Development Measured by CO2 Emissions

Equation 12 aims to measure the impact of international trade indicators on CO_2 emissions, a key environmental indicator of pollution. To select the appropriate estimation method, the necessary pre-tests were conducted for this equation. Table 7 presents the results of these tests.

Table 7. Model Selection Test Results for the Environmental Dimension Model.

Test	Statistics	Prob.
Breusch Pagan	103.16*	0.00
Hausman	27.4*	0.00
Redundant fixed-effect test	26.97*	0.00

Note: * indicates statistical significance at the 1% level.

The results shown in Table 7 indicate that the fixed effects model is the appropriate model for estimating the CO2 emissions function. Additionally, the results of these tests for all Equations 13–15 of the third model indicate that the fixed-effects model is the most appropriate. The estimation results are presented in Table 8.

Table 8. The dependent variable is log (CO2).

Variables	Equation 12	Equation 13	Equation 14	Equation 15
Constant	-1.66 [0.646] (-2.57)*	-2.54 [0.799] (-3.18)*	-1.86 [0.694] (-2.68)*	-2.23 [0.695] (-3.21)*
Log(Energy)	0.51 [0.056] (9.12)*	0.58 [0.072] (8.07)*	0.52 [0.06] (8.7)*	0.53 [0.058] (9.1)*
Log(GDPC)	0.08 [0.035] (2.3)**	0.1 [0.047] (2.13)*	0.08 [0.035] (2.28)**	0.11 [0.037] (2.99)*
Log(TM)	0.08 [0.037] (2.18)**	0.04 [0.054] (0.74)	0.07 [0.038] (1.83)***	0.05 [0.04] (1.26)
Log(TF)	-0.02 [0.013] (-1.53)	-0.01 [0.044] (-0.23)	-0.02 [0.015] (-1.37)	-0.02 [0.012] (-1.62)
Log(TA)	0.01 [0.044] (0.23)	0.06 [0.063] (0.95)	0.02 [0.051] (0.39)	0.08 [0.052] (1.55)
Dum* Log(TM)		-0.01 [0.005] (-1.98)**		
Dum* Log(TF)			-0.01 [0.02] (-0.51)	
Dum* Log(TA)				-0.01 [0.005] (-2.13)**

Note: *, and ** indicate statistical significance at the 1%, and 5% levels, respectively.
The standard error in [ ], and calculated t-values in ( ).

The results of Equation 12 indicate a statistically significant positive impact, complying with expectations, of both energy use and GDP per capita on CO2 emissions. Furthermore, the variable of trade in manufactured goods had a positive impact on carbon dioxide emissions; consequently, trade in manufactured goods did not serve the environmental dimension of sustainable development goals.

In contrast, the impact of trade in fuels, mining, and agricultural products on CO2 emissions was statistically not significant. A possible explanation for this is that an increase in the size of trade in these products does not necessarily translate into increased domestic consumption, since most of the countries in the sample export a significant portion of their production.

Equations 13–15 show the results of the interaction effect of the post-pandemic years with international trade variables. In the post-COVID-19 years, the impact of trade in manufactured goods on CO2 emissions has become negative and statistically significant. This may be attributed to the tendency of Arab countries to import more energy-efficient equipment, as well as the increased imports of renewable energy technologies and electric vehicles.

The results of Equation 14 showed that the post-COVID-19 years had no significant impact on the role of trade in fuel and mining products in either reducing or increasing CO2 emissions. In contrast, the results of Equation 15 showed that trade in agricultural products has reduced CO2 emissions after the COVID-19 pandemic. Specifically, the coefficient of the dummy variable was negative and statistically significant (-0.01). This is explained by the increased reliance on smart agricultural technologies and energy-efficient irrigation systems, as well as improvements in supply chains and the expansion of environmental standards, particularly when exporting agricultural and food products to countries with strict import requirements.

The relatively small magnitude of the agricultural trade coefficient after the COVID-19 pandemic may be attributed to the gradual nature of changes in CO_2 emissions, as environmental impacts typically materialize over time rather than immediately. Therefore, even a modest negative effect may indicate an improvement in the environmental dimension of sustainable development associated with agricultural trade after the pandemic.

Moreover, the post-pandemic period covered in the analysis is relatively short, which may limit the magnitude of observable environmental effects. Nevertheless, the negative sign of the coefficient suggests that agricultural trade after COVID-19 is associated with a slight reduction in CO_2 emissions, which remains economically meaningful from a sustainability perspective, especially when cumulative long-run environmental impacts are considered.

The results in Table 8 indicate that trade in manufactured goods and agricultural goods after the Corona pandemic served the environmental sustainable development index, while the results did not reveal a clear impact of trade in fuel and mining goods on CO_2 emissions.

6. CONCLUSION AND RECOMMENDATIONS

This study analyzed the impact of changes in the structure of Arab trade following the COVID-19 pandemic on economic, social, and environmental dimensions of sustainable development. It employed data from eight Arab countries: Jordan, Saudi Arabia, the United Arab Emirates, Egypt, Tunisia, Morocco, Qatar, and Kuwait, covering the period 2014-2024.

The study reached a number of conclusions. The most important one is that before the Corona pandemic, trade in manufactured goods did not serve the goals of sustainable development in the Arab countries, as it had a statistically significant negative impact on GDP per capita and a statistically significant positive impact on the unemployment rate in the Arab countries. This result contradicts expectations. However, it can be justified by the fact that the volume of manufactured imports exceeds the volume of manufactured exports in the Arab countries, which means that there is a chronic deficit in the Arab manufacturing trade balance, which leads to the leakage of hard currencies abroad. Furthermore, the contribution of this type of trade to local economies is modest for at least two reasons. First, the low technological content of Arab exports of manufactured products, and second, the reliance on imported inputs. The results also indicated a positive impact of trade in manufactured goods on CO_2 emissions.

Post COVID-19 pandemic, the impact of trade in manufactured goods changed as it began to promote various aspects of sustainable development in Arab countries. The results showed a statistically significant positive effect of the dummy variable, which measures the interaction effect of manufactured goods trade on GDP per capita. The positive impact of trade in manufactured goods on the unemployment rate has also decreased. This is due to changes in supply chains and increased reliance on regional trade, in addition to the revitalization of local industries to compensate for import disruptions and increase the degree of substitution. Furthermore, the increase in fuel revenues has contributed to promoting local industries, especially those related to medical, chemical and food products. The Corona period also witnessed the exit of low-productivity and inefficient local industries, which reinforced the positive role of manufactured goods trade on GDP per capita. The results also proved that the impact of trade in manufactured goods on CO_2 emissions after the Corona pandemic has become negative and statistically significant. This may be due to the tendency of Arab countries to import more energy-efficient equipment, and the increased import of renewable energy equipment and electric vehicles.

The results confirmed the presence of a statistically significant positive impact of trade in fuel and mining products on GDP per capita, and a statistically significant negative impact on the unemployment rate. This is explained by the high productivity associated with this sector in most of the countries under study. In turn, high revenues generated from oil and gas exports are utilized to enhance infrastructure, fund the purchase of factors of production that contribute to the growth of other sectors, thus creating positive and sustainable effects on GDP per capita, contributing to job creation as well as reducing unemployment rates.

In contrast, the impact of trade in fuel and mining products on CO_2 emissions was statistically not significant. To measure the interaction effect of the post-pandemic years with trade in fuel and mining products, a dummy variable was added. The results indicated a slight improvement in the impact of trade in fuel and mining products on GDP per capita, compared with not significant impact of trade in fuel and mining products on the unemployment rate and CO_2 emissions.

Finally, the results indicated a statistically significant negative impact of trade in agricultural products on GDP per capita, because agricultural exports of Arab countries are primary products with low value-added, and their revenues are more susceptible to fluctuations due to changes in prices or climatic conditions. All these factors reduce their contribution to achieving sustainable growth in GDP per capita.

The results proved that the impact of trade in agricultural products on the unemployment rate and on CO_2 emissions was statistically not significant. In contrast, the negative impact of trade in agricultural products on GDP per capita has reduced in the years that followed the pandemic. The reason for this is the tendency of Arab countries to rely on local production and to increase food stocks as a precaution measure for any possible future disruptions in supply chains, or significant price hikes, especially for grains and basic food commodities.

The results also showed that trade in agricultural commodities after the Corona period did not have a statistically significant impact on unemployment rates in Arab countries. This result was expected, as enough time must pass before the effect is felt. However, trade in agricultural products after the Corona period had a statistically significant negative impact on CO_2 emissions. This finding can be attributed to the increased reliance on smart agricultural technologies and energy-efficient irrigation systems, as well as improvements in supply chains and the adoption of higher environmental standards, particularly when exporting agricultural and food products to countries with strict import requirements.

To enhance the economic, social, and environmental gains of international trade in Arab countries, the study emphasizes the importance of adopting policies that promote high-value-added exports, support agro-industrial development, and channel oil revenues into sustainable and green investments. It also highlights the need for labor market policies focused on vocational and technical training to reduce skill gaps and unemployment. In addition, the study recommends implementing stricter environmental regulations, encouraging the use of renewable energy in industry, strengthening intra-Arab trade integration, and incorporating sustainability standards into trade agreements in order to achieve more balanced and resilient development outcomes.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Adao, R., Carrillo, P., Costinot, A., Donaldson, D., & Pomeranz, D. (2020). *International trade and earnings inequality: A new factor content approach.* NBER Working Paper No. 28263. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w28263

Ahmadi, Z. K., Rabin, Y. A., & Qadamshahi, H. R. (2025). The impact of trade openness on economic growth of South Asian countries. *Journal of Social Sciences and Humanities, 2*(3), 37-50. https://doi.org/10.62810/jssh.v2i3.129

Ali, A. Y. S., & Dhiif, A. A. (2025). Impact of economic growth, energy consumption, and industrialization on CO2 emissions: Evidence from Somalia. *International Journal of Economics and Financial Issues, 15*(4), 135–143. https://doi.org/10.32479/ijefi.18928

Arce, G., López, L. A., & Guan, D. (2016). Carbon emissions embodied in international trade: The post-China era. *Applied Energy, 184*, 1063-1072. https://doi.org/10.1016/j.apenergy.2016.05.084

Awad-Warrad, T. (2018). Trade openness, economic growth and unemployment reduction in Arab region. *International Journal of Economics and Financial Issues, 8*(1), 179-183.

Baltagi, B. H. (2008). *Econometric analysis of panel data* (4th ed.). Chichester, England: John Wiley & Sons.

Barbero, J., de Lucio, J. J., & Rodríguez-Crespo, E. (2021). Effects of COVID-19 on trade flows: Measuring their impact through government policy responses. *PLoS One, 16*(10), e0258356. https://doi.org/10.1371/journal.pone.0258356

Belloumi, M., & Alshehry, A. (2020). The impact of international trade on sustainable development in Saudi Arabia. *Sustainability, 12*(13), 5421. https://doi.org/10.3390/su12135421

Cao, B., & Wang, S. (2017). Opening up, international trade, and green technology progress. *Journal of Cleaner Production, 142*, 1002-1012. https://doi.org/10.1016/j.jclepro.2016.08.145

Chen, N., Sun, Z., Xu, Z., & Xu, J. (2025). A review of international trade impacts on sustainable development. *Marine Development, 3*(1), 9. https://doi.org/10.1007/s44312-025-00053-6

Chilicaus, F. G. C., Licapa-Redolfo, G. S., Ballesteros, A. M. A., Otazú, C. C. D., Miranda, A. S. J., Castillo, F. M. M., . . . Castillo, J. C. A. (2025). Digital transformation and sustainability in post-pandemic supply chains: A global bibliometric analysis of technological evolution and research patterns (2020–2024). *Sustainability, 17*(7), 3009. https://doi.org/10.3390/su17073009

Choroś-Mrozowska, D. (2022). The impact of COVID–19 on EU-China trade flows. *Comparative Economic Research. Central and Eastern Europe, 25*(4), 161–178. https://doi.org/10.18778/1508-2008.25.34

Cuñat, A., & Melitz, M. J. (2012). Volatility, labor market flexibility, and the pattern of comparative advantage. *Journal of the European Economic Association, 10*(2), 225-254. https://doi.org/10.1111/j.1542-4774.2011.01038.x

Eaton, J., & Kortum, S. (2002). Technology, geography, and trade. *Econometrica, 70*(5), 1741-1779. https://doi.org/10.1111/1468-0262.00352

ESCWA. (2022). *Study on measuring international digital trade in the Arab region.* Beirut, Lebanon: United Nations.

Ghose, A. K. (2004). Global inequality and international trade. *Cambridge Journal of Economics, 28*(2), 229-252. https://doi.org/10.1093/cje/28.2.229

Gonese, D., Sibanda, K., & Ngonisa, P. (2023). Trade openness and unemployment in selected Southern African Development Community (SADC) countries. *Economies, 11*(10), 252. https://doi.org/10.3390/economies11100252

Goswami, A., Kapoor, H. S., Jangir, R. K., Ngigi, C. N., Nowrouzi-Kia, B., & Chattu, V. K. (2023). Impact of economic growth, trade openness, urbanization and energy consumption on carbon emissions: A study of India. *Sustainability, 15*(11), 9025. https://doi.org/10.3390/su15119025

Greene, W. H. (2012). *Econometric analysis* (7th ed.). Upper Saddle River, NJ: Pearson.

Hayakawa, K., & Mukunoki, H. (2021). The impact of COVID-19 on international trade: Evidence from the first shock. *Journal of the Japanese and International Economies, 60*, 101135. https://doi.org/10.1016/j.jjie.2021.101135

Helpman, E. (2010). *Labor market frictions as a source of comparative advantage, with implications for unemployment and inequality.* NBER Working Paper No. 15764. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w15764

International Monetary Fund. (2018). *Economic benefits of export diversification in small states.* Washington, DC, USA: International Monetary Fund.

Krugman, P., & Venables, A. J. (1995). *Globalization and the inequality of nations.* IFN Working Paper No. 430. Stockholm, Sweden: Research Institute of Industrial Economics.

Meinen, P., Serafini, R., & Papagalli, O. (2025). Regional economic impact of COVID-19: The role of sectoral structure and trade linkages. *Open Economies Review*, 1-22. https://doi.org/10.1007/s11079-025-09828-2

Mohsin, A. K. M., Gerschberger, M., Plasch, M., Ahmed, S. F., Rahman, A., & Rashed, M. (2024). Examining the synergy of green supply chain practices, circular economy, and economic growth in mitigating carbon emissions: Evidence from EU countries. *Journal of Environmental Management*, *371*, 123109. https://doi.org/10.1016/j.jenvman.2024.123109

OECD. (2024). *OECD economic outlook, volume 2024 issue 2: Resilience in uncertain times*. Paris, France: OECD Publishing. https://doi.org/10.1787/d8814e8b-en

Ranjbari, M., Esfandabadi, Z. S., Zanetti, M. C., Scagnelli, S. D., Siebers, P.-O., Aghbashlo, M., . . . Tabatabaei, M. (2021). Three pillars of sustainability in the wake of COVID-19: A systematic review and future research agenda for sustainable development. *Journal of Cleaner Production*, *297*, 126660. https://doi.org/10.1016/j.jclepro.2021.126660

Razak, A. R., Saudi, N. D. S., Fernandes, A. A. R., Idris, A., & Rahman, A. M. A. (2025). The impact of trade on environmental quality and sustainable development in ASEAN region. *International Journal of Energy Economics and Policy*, *15*(6), 638-647. https://doi.org/10.32479/ijeep.21298

Riaz, K., Siddique, H. M. A., Audi, M., & Sumaira. (2024). Impact of financial development on export performance: Evidence from South Asia. *Bulletin of Business and Economics*, *13*(3), 539-546.

Riekhof, M.-C., Regnier, E., & Quaas, M. F. (2019). Economic growth, international trade, and the depletion or conservation of renewable natural resources. *Journal of Environmental Economics and Management*, *97*, 116–133. https://doi.org/10.1016/j.jeem.2018.04.008

Sarkar, M. (2023). Environmental sustainability under e-commerce: A holistic perspective. *European Journal of Development Studies*, *3*(3), 1-6. https://doi.org/10.24018/ejdevelop.2023.3.3.252

Ssekibaala, D. S., Ariffin, M. I., & Duasa, J. (2022). Economic growth, international trade, and environmental degradation in Sub-Saharan Africa. *Journal of Economics and Development*, *24*(4), 293-308. https://doi.org/10.1108/JED-05-2021-0072

Steen-Olsen, K., Weinzettel, J., Cranston, G., Ercin, A. E., & Hertwich, E. G. (2012). Carbon, land, and water footprint accounts for the European Union: Consumption, production, and displacements through international trade. *Environmental Science & Technology*, *46*(20), 10883-10891. https://doi.org/10.1021/es301949t

Tandra, H., Mahendri, I. G. A. P., Sujianto, S., Rifai, B., Salim, Z., da Silva, H., & Pujiharti, Y. (2025). The impact of trade with border effect on GDP per capita: Global evidence. *Economies*, *13*(6), 174. https://doi.org/10.3390/economies13060174

UNCTAD. (2026). *Global trade update: Reforming trade rules to drive development*. https://unctad.org/system/files/official-document/ditcinf2026d3_en.pdf

Vijayasri, G. V. (2013). The importance of international trade in the world. *International Journal of Marketing, Financial Services & Management Research*, *2*(9), 111-119.

Zi, S., Pan, Z., & Wang, Y. (2026). Trade agreements and trade-embedded carbon: An environmental provisions perspective. *Sustainability*, *18*(2), 1066. https://doi.org/10.3390/su18021066