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The Impact of Financial Sustainability on Export Volume: An Econometric Study Using Panel Models for Algeria and a Group of Arab Oil-Growing Countries during the Period (2004-2023)

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Abstract---This study aimed to assess the impact of fiscal sustainability on the volume of exports, using a panel data approach for Algeria and a group of oil-exporting Arab countries over the period 2004–2023. The analysis was conducted using the Panel ARDL model, which is suitable for examining both short-run and long-run dynamics in panel data settings. The results revealed the existence of a long-run cointegration relationship between fiscal sustainability indicators and the volume of exports (EXP), indicating that these variables move together over time. The study also found statistically significant effects in both the short and long run. Furthermore, the error correction term (Cointeq (-1) = -0.14) was negative and statistically significant, confirming the presence of a short-run adjustment mechanism toward long-run equilibrium. Specifically, about 14% of any short-term deviation from equilibrium is corrected in the subsequent period, suggesting a stable and gradual adjustment process. These findings support the hypothesis that enhancing fiscal sustainability contributes positively to improving export performance, particularly in oil-dependent economies, through better resource allocation and increased macroeconomic stability.

Keywords---Fiscal Sustainability, Exports, Panel ARDL, Algeria, Oil-exporting Countries.

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1. Introduction

In light of the changing dynamics of the global economy and the increasing severity of geopolitical and economic crises, the concept of financial sustainability has emerged as one of the fundamental pillars that ensure the continuity of economic performance and the stability of public finances, especially in rentier countries that are excessively dependent on a single resource, like oil. Algeria is a model for this type of economy, as oil revenues remain the primary source of funding for the general budget, leaving it vulnerable to energy price shocks and global market fluctuations.

This structural dependence on hydrocarbon revenues generates chronic financial fragility, manifested in recurring budget deficits and high state debt, which weakens the government's ability to invest in productive sectors and develop an export base outside the hydrocarbon sector. Fluctuations in revenue also lead to reduced investment spending, especially during periods of low prices, which weakens infrastructure and negatively impacts the competitiveness of the national economy.

From a macroeconomic perspective, fiscal sustainability, which refers to a government's ability to finance its current and future spending without excessive debt increases or resorting to exceptional resources, is a critical component in providing a stable and growth-enhancing economic environment. When fiscal policy is managed efficiently, it enables governments to direct resources toward productive sectors, improve the investment climate, and enhance the national economy's export capabilities.

Conversely, the export sector is one of the main drivers of long-term economic growth, contributing to improving the balance of payments, diversifying sources of income, and reducing dependence on external sources. However, these goals cannot be achieved without a sustainable financial framework that provides a minimum level of stability and confidence among economic actors, both local and international.

Therefore, the importance of studying the relationship between financial sustainability and exports is highlighted, particularly in rentier countries, where irrational financial policies can pose a significant obstacle to export sector development. In this context, this study examines this relationship in Algeria and a group of Arab oil-producing countries over the period (2004–2023) by using Panel Data Models, which allow for a joint analysis of time characteristics and cross-sectional units, providing more accurate and in-depth results for understanding the nature and direction of the relationship.

• The problem of the study:

- The study seeks to answer a central question: To what extent does financial sustainability contribute to supporting export performance in economies that rely heavily on natural resources? It also focuses on testing theoretical hypotheses related to the relationship between financial discipline and external competitiveness, within an economic environment characterized by structural fluctuations and geopolitical challenges, Through this analysis, the study seeks to provide accurate benchmark results that can contribute to formulating effective financial policies that take into account the external dimension of the economy, and support efforts to diversify the economy and reduce dependence on oil rents, in line with the requirements of sustainable development and the financial reform agendas adopted in these countries. Based on the above, the problem can be formulated as follows:

-To what extent can financial sustainability affect the volume of exports in Algeria and the group of Arab oil countries during the period (2004-2023)?

- To answer the main question, we put forward the following hypotheses:
- There is a joint integration relationship between financial sustainability indicators and the volume of exports in Algeria and the group of Arab oil countries during the period (2004-2023).
- There is a significant effect between the financial sustainability indicators and the volume of exports in Algeria and the group of Arab oil countries during the period (2004-2023).

Importance of the study:

- The importance of this research stems from the fact that financial sustainability is considered a fundamental indicator of the effectiveness and efficiency of financial policy in any country, as it reflects the extent of its ability to achieve a balance between public revenues and expenditures, and reduce reliance on public debt. Financial sustainability is not only a goal in itself, but a means of evaluating the success or failure of the economic policies pursued.
- Because of its direct impact on macroeconomic variables, this importance is evident in both developed and developing countries. However, its effects are more evident in developing countries that suffer from weak economic structures and fragile public finances.
- In particular, Algeria and the Arab rentier countries face profound economic and structural challenges represented by fluctuations in oil revenues, high deficit and public debt rates, in addition to export challenges due to their dependence on a single source of export. In particular, they face a number of profound economic and structural challenges; the most prominent of these is the heavy reliance on oil revenues, which are characterized by sharp fluctuations, leading to instability in public revenues. The country also suffers from a worsening fiscal deficit and public debt, in addition to a limited export base due to its near-total reliance on a single source of exports. This weakens the economy's resilience to external shocks and limits its international competitiveness. Hence, the urgent need to study the impact of financial sustainability on exports, with the aim of arriving at visions and policies that contribute to achieving long-term economic stability, achieving optimal utilization of economic resources, and protecting the rights of future generations in light of limited resources and increasing development needs.

Study objectives:

- Measuring the impact of financial sustainability on export performance in Algeria and some Arab oil-producing countries during the period (2004–2023), using dynamic panel models.
- Determining the relationship between fiscal policy components (revenues, expenditures, public debt) and external sector performance, particularly exports.
- Exploring the nature of dependence on single resources (such as oil) and its impact on the sustainability of public finances and the economy's ability to diversify its exports.

Study methodology:

- Based on the research problem and its objectives, we relied in this research on reviewing previous studies that addressed the research topic. We also relied on the quantitative approach using dynamic panel models, which provide a more comprehensive study considering the integration of the characteristics of the individual dimension of the sample countries as well as the characteristics of the time dimension separately, providing a more detailed view of the impact of financial sustainability on export volume, EVIEWS 13 software was used to ensure the accuracy and reliability of the results.

Search structure:

The appropriate model for the study data:

In order to achieve the objectives of the study, the necessary and appropriate tools were used for each stage of the study, and this was through studying the impact of financial sustainability on the volume of exports, a standard study using panel models for Algeria and a group of Arab oil countries during the period (2004-2023), using cross-sectional time series data analysis PANAL –DATA, this is in line with the available data, as long-term data are defined as cross-sectional observations measured in a specific period of time. The characteristics combine cross-sectional data and time series at the same time. Among the most important cross-sectional data used in standard measurement, we find (the aggregate regression model, the fixed effects model, and the random effects model), in addition to testing the comparison between the panel models, this was done using the statistical program EVEIWS 13 (Badi H. Baltagi, 2023, pp. 2-3).

- Study limitations: Our study is defined by two aspects:

- Spatial boundaries:

The study focused on the impact of financial sustainability on the volume of exports, an econometric study using panel models for Algeria and a group of Arab oil countries (Iraq, Saudi Arabia, the United Arab Emirates, Qatar, Bahrain, and Kuwait).

• Time limits: The study covered the period from (2004-2023).

2. Previous studies

Study: (Al-Fatlawi, 2024), Measuring the Impact of Economic Diversification Policy on Achieving Financial Sustainability - Experiences of Selected Countries with Reference to Iraq, Master's Thesis in Economic Sciences.

This study aimed to examine the impact of economic diversification on achieving financial sustainability, with a focus on rentier countries such as Iraq. The researcher argues that excessive reliance on oil exposes the economy to external and internal shocks, leading to financial imbalances. Hence, the importance of economic diversification as a mechanism for enhancing long-term financial stability is highlighted.

The research is based on the inductive and deductive approach, using the Autoregressive Distributed Lag (ARDL) model to analyze data from three countries (China, UAE, Iraq). The most important results: Economic diversification actually contributes to enhancing financial sustainability by reducing dependence on oil.

Increasing non-oil revenues and achieving a more sustainable fiscal balance. Recommendations: The need to adopt clear economic policies that support diversifying the production base and revitalizing non-oil sectors.

• A study (Ali and Banafa, 2016) entitled: Evaluating Financial Sustainability in the Kingdom of Saudi Arabia: An Applied Study for the Period (1969-2015) This study aimed to analyze the ability of the financial authorities in the Kingdom of Saudi Arabia to achieve financial sustainability by using the time constraint of the general budget during the period (1969-2015). The results of the Granger causality test concluded that there is a two-way causal relationship between public expenditures and public revenues ddemonstrating the ability of financial authorities to make simultaneous decisions regarding public expenditures and public revenues.

• A study (Verme and Shibut, 2022) entitled: An analytical econometric study of the impact of financial sustainability on economic growth in Algeria during the period (2000-2020), This study aimed to study the measurement and analysis of the impact of financial sustainability indicators on economic growth using the developed Dickey-Fuller test to test the stability of the study variables using the cointegration model according to the ARDL methodology, the study found a long-term equilibrium relationship between financial sustainability and economic growth, in addition to an inverse relationship between financial sustainability indicators and economic growth: as the public debt ratio increases, economic growth declines.

• A study (Ben Issa, Bouzian, and Bouknadel, 2020) entitled: Financial Sustainability and Economic Diversification in Algeria during an Econometric Study for the Period (2000-2018), This study aimed to measure the impact of diversification in public revenues and economic diversification on financial solvency and the parallel deficit. The study concluded that financial solvency is highly related to oil price fluctuations and that regular taxation has no effect on it, the industrial sector's share of GDP has a positive impact, and there is a long-term relationship between public expenditures and public revenues. Financial sustainability is lacking in Algeria, so revenue sources must be diversified, particularly regular taxation, and sectors outside the oil sector must be activated.

• A study (Al-Shaib and Hamra, 2022) entitled: The extent to which financial sustainability indicators contribute to achieving economic growth in Egypt. This study aimed to examine the extent to which financial sustainability indicators contributed to economic growth during the period (1980-2018) for both the short and long term, by using the ARDL Bounds Test method. The unconstrained error correction model was also used UECM, The study concluded that there is a balanced and dynamic relationship in the long and short term between financial sustainability indicators and economic

growth, in addition to the existence of a disparity in the contribution of sustainability indicators to economic growth in the long term both government spending and external debt contributed positively and significantly to economic growth, in contrast to government revenues, which did not contribute significantly to economic growth.

• A study (Warhill and Deldar, 2024) entitled: The impact of financial sustainability on economic growth in Iraq during the period (2004-2022). This study aimed to estimate the impact of some financial sustainability indicators represented by (public debt, oil revenues, public spending, interest rates, inflation, exchange rate) and economic growth measured by (gross domestic product) using the autoregressive distributed lag model ARDL. The study found a long-term equilibrium relationship between financial sustainability and economic growth, with oil revenues among the most important variables affecting economic growth, followed by government spending in second place, the exchange rate in third place, followed by the total public debt variable, and finally the inflation rate.

Standard study:

Most modern studies rely on the use of statistical tools to measure the relationship between variables in order to arrive at accurate results that enable their users to know the direction of the phenomenon being studied in the short or long term. They also enable the researcher to measure the variables with each other in order to make sound decisions. Accordingly, in this context, panel models will be adopted, which are considered more appropriate for measuring the impact of financial sustainability on the volume of exports. A standard study using panel models will be conducted for Algeria and a group of Arab oil countries during the period (2004-2023).

1.3. Study data sources and sample variables:

1.1.3. Study data sources:

Our study data were obtained through the World Bank website database,

2.1.3 Study sample:

The study sample consists of Algeria and a group of Arab oil countries (Iraq, Saudi Arabia, United Arab Emirates, Qatar, Bahrain, and Kuwait).

2.3 Method and tools:

Through this study, we will attempt to identify the dependent variable represented by the volume of exports (EXP), and the independent variable represented by the financial sustainability indicators, which are as follows: total public debt to GDP (DEGD), surplus or deficit to GDP (SUGD), tax gap (TAG), ratio of oil revenues to public revenues (OIPR), ratio of public revenues to public expenditures (PUPU), Depending on what the economic theory has brought, as well as depending on previous studies that have dealt with and dealt with this topic, in addition to taking into account the nature and specificity of the Algerian economy, therefore our study was limited to the impact of financial sustainability on the volume of exports, a standard study using panel models for both Algeria and a group of Arab oil countries during the period (2004-2023), The data for the study were obtained from the World Bank database for the period 2004-2022, where the validity of the appropriate model for the dependent variables will be estimated and selected according to the nature of the study data and what it provides in terms of hypotheses and factors that enter into studying the phenomenon, relying on the Eviews13 program. The estimation process will be based on a linear model, and the model will be formulated through economic theory, prepared for the dependent variable that relates to the study problem.

2.3 Results and discussion:

- Testing the correlation between the cross-sections of the study variables:

The cross-sectional correlation test (CDS) is one of the appropriate statistical methods for analyzing study variables. The results of the most famous tests prepared for this purpose require the rejection of the null hypothesis, which means the existence of a cross-sectional correlation between the study series.

This is due to the significance of the parameters of these estimates for this test. The table below illustrates this:

Table 1: Cross-sectional correlation test

Pesaran Cd	PESARAN SCALED LM	BREUSCH–PAGAN LM	variable
Dependent variable			
6.70 0.00	24.00 0.00	207.60 0.00	Exports
Independent variables			
7,11 0.00	17,49 0.00	158,95 0.00	DEGD
5,11 0,00	14,42 0,00	135,96 0,00	SUGD
10.05 0.00	14.11 0.00	133.64 0.00	TAG
9,20 0.00	12.16 0.00	119.06 0.00	OIPR
2.14 0.00	5.30 0.00	67.70 0.00	PUPU

Source: Prepared by the researcher based on the outputs of the EVIEWS.13 program.

- HSIAO homogeneity test (Cheng, 1986):

This test aims to find out the homogeneity of the parameters of the estimated model by considering a sample consisting of T observations for N individuals in the group. We also assume that the path is defined by the following linear relationship:

$\alpha_i + \beta X_{it} + \varepsilon_{it} = y_{i.t}$.....(1)

The error term ε_it is assumed to be independent and symmetrically distributed with zero mean and variance equal to σ_i^2. It is also assumed that the model parameters α_i and β_i can vary in the individual dimension but are constant in time. Therefore, this model represented by the equation can take several possible forms as follows:

The constants α_i and the vector parameters β_i are identical, find that: α_i - α, β_i - β, ∀_i∈[1,N] and so we say that we have a homogeneous series.

The constants α_i and the vector of parameters β_i differ according to individuals, so we say that there are N different models and therefore we reject the chain formula.

The constants α_i and the vector of parameters β_i are identical across the individual items, such that α_i - α ∀_i∈[1,N], in this case we say that all the model parameters except the constants are different across the individual items, and thus we say that there are N distinct models.

The constants α_i and the vector of parameters β_i are identical across the individual items of the group, such that β_i - β ∀_i∈[1,N], in this case we obtain a single-effects model.

From an economic perspective, choosing a description allows us to know whether the theoretical model under consideration is identical for all samples or vice versa, i.e., whether each sample has different characteristics and features.

Table 2: Results of the homogeneity test of Hsiao, C. (1986)

Specification Tests of Hsiao (1986)

H1 = Null Hypothesis : panel is homogeneous vs Alternative Hypothesis : H2
H2 = Null Hypothesis : H3 vs Alternative Hypothesis : panel is heterogeneous
H3 = Null Hypothesis : panel is homogeneous vs Alternative Hypothesis : panel is partially homogeneous

Hypotheses	F-Stat	P-Value
H1	49.81092	3.22E-55
H2	11.01894	9.70E-23
H3	71.65938	4.58E-44

This program has developed by Brahim KHOUILED
Jniversity of Ouargla, Algeria

Source: Prepared by the researcher based on the outputs of the EVIEWS.13 program.

Based on the results of Hsiao, C. (1986) homogeneity test, shown in the table:
Model fit tests are a fundamental step in panel data analysis, where the choice is made between three models: pooled OLS, fixed effects, and random effects. In this context, the F test is specifically used to compare pooled and fixed effects models.
The test is based on the null hypothesis H_0, which states that all coefficients related to cross-sectional units (such as countries or individuals) are equal, meaning there are no significant differences between them, and therefore the clustering model is sufficient. The alternative hypothesis H_1 assumes fixed effects between cross-sections, which requires the use of a fixed-effects model.
In the case mentioned, the probability value (p-value) was equal to 0.00, i.e. less than the 5% significance level, which leads to rejecting H_0 and accepting H_1, which means that there are significant differences between countries (study sections), and therefore the fixed effects model is the most appropriate.
The p-value corresponding to the F1 statistic, which is equal to 0.00, is less than 5%. Therefore, the null hypothesis H0 is rejected and the alternative hypothesis H1 is accepted. We assume that there is a relationship between the effects of the study sections (the countries in the study sample), so using the effects model is appropriate. In general, the panel regression model is based on a set of assumptions that ensure the validity of the model's use in the prediction process and in testing the study's hypotheses, especially those related to coefficients and constants.

- Based on the F2 statistic, the probability value (P-value) for this statistic, which is equal to 0.00, is less than 0.05, and therefore the null hypothesis (H0) for this statistic is rejected.
- The F3 statistic shows that the probability value (P-value) for this statistic is equal to 0.00, less than 0.05, and therefore the null hypothesis (H0) for this statistic is rejected.

Therefore, we say that there is a random individual effect among the study data.

- Determine the appropriate model for the data:

We get the panel model for the variable Export Volume EXP:

$$EXP = a + \beta 1 DEGD_{i,t} + \beta 2 SUGD_{i,t} + \beta 3 OIPR_{i,t} + \beta 4 TAG_{i,t} + \beta 5 PUPU_{i,t} \mu_i + Y_t + \mathcal{E}_{i,t}$$

Where:

- EXP: Export volume
- DEGD: Gross public debt to GDP
- PUPU: Surplus or deficit to GDP
- SUGD: Ratio of public revenues to public expenditures

- OIPR: Ratio of oil revenues to public revenues
- TAG: Tax gap
- a: General sector parameter in the model
- iβ: Coefficients of explanatory variables
- μ_i: Unobserved cross-section effects that vary from country to country but remain constant over the same time period.
- 〖Y〗_t: Unobserved time effects that vary across the countries under study and change over time.
- E_(i,t): Random error term, which must be independent and identically distributed.

The model accompanying the nature of the sample data is determined by how to deal with individual effects or unobserved heterogeneity. We will estimate the above equation using the least squares method, and on the basis of the long-term study data, we distinguish three models: the static panel model, the POOLED model, The fixed effect model (MEF) and the random effect model (MEA) are estimated using the ordinary least squares method, while the third model is estimated using the generalized least squares method. Then, we compare the models:

Table No. 3: Estimation of the appropriate model for the study sample data

Dependent variable: export volume EXP			
Number of views N*T=160 N= 8 T= 20 20042023 : Time period			
Random effect model	Fixed effect model	Aggregate model	explanatory variables
-1.54 0.70	-1.45 0.71	-3.93 0.71	DEGD
-9.50 0.34	-9.91 0.32	3.89 0.00	SUGD
***-9.58 0.00	***-9.98 0.00	***3.52 0.00	PUPU
***-9.12 0.00	***-9.97 0.00	3.74- 0.56	OIPR
1.17 0.27	1.15 0.28	-1.57 0.93	TAG
(3.10) (0.12)	***3.42 (0.00)	***-3.14 (0,00)	Fixed limit
0.15	0.79	0.07	R-squared
1.34	1.34	2.77	S.E.of regression
5.59	46.31	2.56	F-statistic
0.000	0.000	0.000	Prob (F-statistic)

Source: Prepared by the researcher based on the outputs of the EVIEWS.13 program.

(): represents the calculated statistic for the parameter estimates for the STUDENT test.
*,**,***, indicate the significance level at 1%, 5%, 10%.
- Comparison between the three estimated models:
We will first determine the presence or absence of an individual effect within the study sample data. We will use a Fisher test, whose null hypothesis fits the model of total homogeneity, meaning there is no effect of individuals in the sample being studied. The statistic of this test is:
H0: The clustered regression model is the appropriate model.
H1: A fixed or random effects model is appropriate.

$$F_1 = \frac{(R2MNC - R2MC)/(N-1)}{1 - R2MNC/(N \times T - n - k)}$$

Where:
N: represents the number of individuals (in our case, 8 countries).
T: represents the length of the time series proposed in the study (in our case, 21 years).
K: the number of exogenous variables in the model. In our case, we have five independent variables.
R2FEM: represents the multiplicative coefficient of determination, i.e., under the null hypothesis, in this case, a model with no effect, i.e., a model of total homogeneity (R2FEM = 0.07).
R2PRM: The multiplicative coefficient of determination for the unconstrained model, i.e., under the reversed hypothesis, in this case, the fixed-effect model (R2PRM) = 0.79.
Applying Fisher's law gives us a calculated value of Fc = 75.94, while the tabulated statistic reached 3.04 (Ftab (7,155) = 3.04). Therefore, we reject the null hypothesis at a 5% significance level and say that there is an individual effect within the sample data.
- Impact quality test:
HAUSMAN test:
Fisher's test, which shows the presence of a single effect, determines the type of effect using the Housman test to choose between a fixed-effect or random-effect model. The results of this test are as follows:
H0: The random-effects model is appropriate
H1: The fixed-effects model is appropriate

Table 4: Hausman test results

Correlated Random Effects - Hausman Test
Pool: PAYS
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	3.972208	5	0.5534

Source: Prepared by the researcher based on the results of 13EVIEWS.

Through the results of the Avios13EVIEWS program, and based on the HAUSMAN test, we note that the calculated statistic 3.97=Chi-square, is less than the tabulated statistic which is equal to 11.07, and this is at a confidence level of 0.05, and from this we accept the null hypothesis, meaning that there is a difference between the explanatory variables and the individual effect, and from this the appropriate model for the study sample data is of the random effect type MEF, And so the coefficient of determination increases, and therefore each section has its own effect. The table below represents the results of the random effects of the model for each country:

Table 5: Random effects results for the model for each country

Impact	State
7.62	Iraq
-1.36	Algeria
-1.39	United Arab Emirates
-5.34	Saudi Arabia
-9.08	Qatar

Impact	State
-4,34	Oman
-9.22	Bahrain
1.84	Kuwait

Source: Prepared by the researcher based on the outputs of the EVEIWS13 program

We note from the previous table that there is a difference in the individual random effect between the countries under study between the fixed random effect and the negative random effect, as a positive effect was recorded in both Iraq and Kuwait, and a negative individual random effect was recorded in each of Algeria, Saudi Arabia, the United Arab Emirates, Qatar, and Oman.

- Random effects model (MEF) evaluation

After it has been shown that the appropriate model is the random effects model through the results of the previous tests, and accordingly, the model equation can be written as follows:

$$\exp = 3.10 - 1.54\text{degdit} - 9.50\ \text{SUGD}_{.} - 9.58\text{OIPR} - 9.12\text{PUPU} + 1.17\text{TAG} + \text{et}$$

Economic evaluation:

Through the results of estimating the random effect model recorded in the previous equation, it is clear that the following:

The total public debt to GDP ratio (DEGD) has an inverse relationship that is not significant and inconsistent with economic theory with the volume of exports, as when the total public debt to GDP ratio (DEGD) increases by 1%, it will lead to a decrease in the volume of exports by 1.54%.

The ratio of public revenues to public expenditures (SUGD) has an inverse relationship that is not significant and inconsistent with economic theory with the volume of exports, as increasing the ratio of public revenues to public expenditures (SUGD) by 1% will lead to a decrease in the volume of exports by 9.50%.

The ratio of oil revenues to public revenues (OIPR) has a significant inverse relationship that is not in accordance with economic theory with the volume of exports, as when the ratio of oil revenues to public revenues (OIPR) is 1%, it will lead to a decrease in the volume of exports by 9.58%.

The surplus or deficit to GDP (PUPU) parameter has an inverse relationship that is not consistent with economic theory with the volume of exports, as when the surplus or deficit to GDP (PUPU) increases by 1%, it will lead to a decrease in the volume of exports by 9.12%.

The tax gap parameter TAG has a positive, insignificant relationship that is not consistent with economic theory with the volume of exports, as increasing the tax gap TAG by 1% will lead to an increase in the volume of exports by 3.10%.

Statistical evaluation:

The coefficient of determination shows that R2 = 15%. This means that the variables occurring in exports (exp) are determined within the model, i.e. they are determined by the variables of the explanatory model, which is a small percentage, while a large percentage remains within the margin of error.

The Fisher test indicates the overall significance of the model at the 5% level, which means that the explanatory variables as a whole have the ability to explain the change in the dependent variable, the volume of exports (EXP). The Student test also shows us that the independent variables are mostly not significant at the 5% confidence level.

The Durbin-Watson DW test also indicated the presence of autocorrelation of errors 29DW=0. This means that the errors are autocorrelated, making the parameter estimates inconsistent. This means that the model is weak from a standard perspective. Therefore, the model estimated in the static panel data is weak, which allows us to estimate the relationship in both the short and long run.

- Estimating the relationship in the short and long term (dynamic panel model PANAL ardl):

1. Time series stationarity and unit root testing for panel data:

The correct methodology followed by the researcher in standard studies before the estimation process, and before verifying the existence of a joint integration relationship between the study variables, is that it is necessary first to ensure the stability of the time series, as the problem of the instability of time series, It leads the researcher to make a false estimate, which gives us biased estimates. Among the most famous stability tests for panel models, we mention:

- Test: LLC-2002 (Levin, Lin, and Chu).
- Test: IPS-2003 (Im, Pesaran, and Shin).
- Test: 2ADF-Fisher X.
- Test: PP FISHER X2.

Table 6: Unit root test for panel data

Unit root test results for panel data							
Independent variable and dependent variables							
TAG	PUPU	OIPR	SUGD	DEGD	EXP	Variables	
؛ (LLC-2002) Levin, Lin et Chu							
-2.44	-4.67	-3.90	-0.41	-8.44	-2.47	Test parameter	
0.00	0.00	0.00	0.34	0.00	0.00	Probability value	level
8.55	-	-	-9.08	-_	-	Test parameter	The first
0.00	-	-	0.00	-		Probability value	differenc e
(IPS-2003) Im, Pesaran et Shin							
-1.78	-3.28	-2.48	-1.03	-5.44	1.33	Test parameter	
0.03	0.00	0.00	0.14	0.00	0.00	Probability	level
-8.64	-	-	-6.20	-	-	Test parameter	The first
0.00	-	-	0.00	-	-	Probability	differenc e
ADF							
28.90	39.38	32.88	24.72	87.69	24.42	parameter to test	
0.02	0.00	0.00	0.07	0.00	0.00	Probability	level
87.46	-	-	64.05	-	-	Test parameter	The first
0.00	-	-	0.00	-	-	Probability	differenc e
PP FISHER X^2							
24.75	42.09	33.66	33.83	101.84	38.17	Test parameter	level
0.07	0.00	0.00	0.00	0.00	0.00	Probability	
128.98	-	-	-	-	-	Test parameter	The first
0.00	-	-	-	-	-	Probability	differenc e
I(1)	I(0)	I(0)	I(1)	I(0)	I(0)	Degree of integration	

Source: Prepared by the researcher based on the outputs of the EVEIWS13 program

Through the outputs of the EVEIWS.13 program, and based on the stability tests of the unit root test for the panel data, we note that the dependent variable, exports EXP, stabilized at the level difference I(0), and the independent variables, financial sustainability variables, stabilized at the level except for the variable of the ratio of public revenues to public expenditures SUGD and the variable of the tax gap TAG, where it settled after taking the first difference I(1), and accordingly we acknowledge the existence of integration between the data, and to prove this we will rely on the simultaneous integration test for the Pedroni panel data.

2. Simultaneous integration relationship of panel data:
After confirming the degree of integration of the Panel data for the group, by conducting unit root tests, we will now choose the possibility of the existence of a simultaneous integration relationship between the variables by applying the Pedroni test. In the first stage, we work to achieve the Pedroni 1999 test, which takes into account the case of heterogeneity between the units (countries). It also presents two sets of tests. The first set includes four statistics that help discover the possibility of a simultaneous integration relationship between variables in each country. The second set includes three statistics calculated based on the individual statistical averages for all samples. This set enables us to determine the possibility of a simultaneous integration relationship between countries.

Table 7: Results of Pedroni tests for cointegration.

p_v Probability	Test parameter	Estimated model
Joint autoregressive(ρ) parameter		(WITHIN-DIMENION) Internal dimension
0.96	1.87-	Panel V-statistic
0.78	-0.77	Panel RHO –statistic
0.02	-2.43	Panel PP-statistic
0.02	-2.39	Panel ADF-statistic
Inter-dimension between- dimension		
0.97	-2.05	Group RHO-statistic
0.00	-3.32	Group PP-statistic
0.00	-2.10	Group ADF-statistic

Source: Prepared by the researcher based on the outputs of the EVEIWS13 program

Most of the results of the PEDRONI tests for cointegration indicate the presence of cointegration, two (02) tests for the internal dimension (within-dimension) and two (02) tests for the inter-dimension (between-dimension), provided that the probability value associated with the statistic for each test is less than 5%, and thus the presence of a simultaneous integration relationship between the sustainable development variables and the volume of exports EXP is accepted.

1. Degree of integration of variables:
The aim of the (BELLOMi) test is to conduct the stationarity test to ensure that the degree of integration of the variables is not (2) I. This is to avoid errors in estimation and the presence of degree 2 integration of variables does not allow us to interpret the results of the F-stat test generated by Persaran and al (2001). After conducting the stationarity test as shown in the table below, and after conducting the stationarity test, it becomes clear that:

Table 8: Results of the integration degree test for the study variables

Degree of integration	At 1érdifference	At level	Variables
I(0)	-	stable	EXP
I(0)	-	stable	DEGD
I(1)	stable	unstable	SUGD
I(0)	_	stable	PUPU
I(0)	_	stable	OIPR
I(1)	stable	unstable	TAG

Source: Prepared by the researcher based on the outputs of the EVEIWS13 program

2. Estimation and analysis of the dynamic panel model

After studying the degree of integration of the explanatory variables, the financial sustainability variables (total public debt to GDP DEGD, Surplus or deficit to GDP PUPU, ratio of public revenues to public expenditures SUGD, ratio of oil revenues to public revenues OIPR, tax gap (TAG) on oil and the dependent variable exports EXP, which are integrated at degree I(0) and degree I(1) and shown in the table for the degree of integration. Accordingly, we will estimate PANAL-ARDL, for the model exports using the integrated mean group methodology. POLED MEAN GROUP.

Model estimation:

- The optimal model among the selected models is the Ardl (4.1.1.1.1) panal model, using the (AIC) criterion, where the relationship was estimated for the panal dynamic Battl model using the integrated mean group methodology (POLED MEAN GROUP), for the long and short term in addition to the error correction limit:

Table 9: Model estimation results (4.1.1.1.1.1) panal –ardl pmg

Dependent Variable: D(EXPP)
Method: ARDL
Date: 07/29/25 Time: 16:41
Sample: 2008 2023
Included observations: 126
Maximum dependent lags: 5 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): DEGD SUGD PUPU OIPR TAG
Fixed regressors: C
Number of models evalulated: 5
Selected Model: ARDL(4, 1, 1, 1, 1, 1)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
DEGD	-1.16E+13	1.46E+13	-0.797007	0.4280
SUGD	2.42E+15	1.17E+15	2.067726	0.0422
PUPU	5.54E+15	2.45E+15	2.264563	0.0265
OIPR	5.76E+15	4.20E+15	2.371610	0.0436
TAG	-4.14E+17	2.44E+17	-2.698658	0.0335
Short Run Equation				
COINTEQ01	-0.145940	0.069612	-2.096494	0.0395
D(EXPP(-1))	0.005625	0.124648	0.045124	0.9641
D(EXPP(-2))	-0.352474	0.182260	-1.933906	0.0569
D(EXPP(-3))	0.025643	0.160358	0.159912	0.8734
D(DEGD)	-2.65E+15	1.93E+15	-2.373169	0.0038
D(SUGD)	-8.15E+15	8.40E+15	-0.970983	0.3347
D(PUPU)	3.58E+15	3.83E+15	0.934770	0.3529
D(OIPR)	4.20E+16	4.20E+16	1.000386	0.3204
D(TAG)	-1.20E+18	1.23E+18	-0.978408	0.3311
C	5.11E+17	4.84E+17	1.056632	0.2941

Source: Prepared by the researcher based on the outputs of the EVEIWS13 program.

From the table:

Long-term analysis:

The ratio of total public debt to GDP (DEGD) has an insignificant and inconsistent inverse relationship with the volume of exports (EXP). A 1% increase in the ratio of total public debt to GDP (DEGD) leads to a 1.16% decrease in exports. This can be explained by several economic and circumstantial factors. Theoretically, public debt is not supposed to have a direct and negative impact on exports; rather, it depends on how the debt is used. If public debt is directed toward financing infrastructure investment spending and facilities aimed at supporting production and exports, this may contribute positively to stimulating exports. However, in the case of a well-studied economy, public debt may be largely directed toward covering the current account deficit or unproductive consumer spending, this does not translate into a real boost to export capacity. Furthermore, high public debt may

contribute to inflationary pressures or higher interest rates, weakening the competitiveness of local products in foreign markets.

- In addition, the statistically insignificant relationship suggests that this effect may be weak or unstable, and may be affected by other factors not included in the model, such as the exchange rate, the efficiency of trade policies, or the quality of institutions.
- The parameter of the ratio of public revenues to public expenditures (SUGD) has a significant positive relationship with the volume of exports, as increasing the ratio of public revenues to public expenditures (SUGD) by 1% will lead to an increase in the volume of exports by 2.42%.
- This positive correlation reflects that improving the efficiency of public finances through increasing the ratio of revenues to expenditures enhances the country's financial stability and provides a wider margin for financing investments in productive sectors and infrastructure that support export activity. Furthermore, the increase in revenues compared to expenditures may indicate the presence of sound financial policies that reduce reliance on public debt.
- This increases general economic confidence, improves the business environment, and encourages investors and exporters to expand. Furthermore, this indicator may reflect improved overall economic performance, which is often linked to increased productivity and competitiveness in the external sector.
- The ratio of oil revenues to public revenues (OIPR) has a significant positive relationship with the volume of exports, where a ratio of oil revenues to public revenues (OIPR) of 1% will lead to an increase in the volume of exports by 5.76%. This strong positive relationship indicates the great importance that oil exports occupy in the structure of total exports, especially in a rentier economy that relies primarily on the hydrocarbon sector as the primary source of public revenue. The higher the percentage of oil revenues, the more oil exports, which typically constitute the largest portion of national exports. Furthermore, increased oil revenues may contribute to providing financial liquidity for the government, which can be used to improve infrastructure and logistics services, this, in turn, enhances the economy's ability to export. However, on the other hand, this correlation may also indicate the fragility of economic diversification, as exports remain subject to fluctuations in global oil prices.
- The surplus or deficit to GDP (PUPU) parameter has a significant positive relationship, consistent with economic theory, with the volume of exports, as when the surplus or deficit to GDP (PUPU) increases by 1%, it will lead to an increase in the volume of exports by 5.76%.
- This correlation reflects that improving the financial position of the governments in the study sample, whether through reducing the deficit or achieving a general budget surplus, contributes to enhancing the economy's ability to export. When the budget balance improves as a percentage of GDP, The state's ability to invest in infrastructure, develop productive sectors, and stimulate export sectors increases through support or improving the economic climate.
- A general budget surplus often reflects effective financial management and economic stability, which increases confidence in the economy and enhances its external competitiveness. This is consistent with the theoretical view that links financial stability with improved external economic performance.
- The tax gap parameter TAG has an inverse and insignificant relationship with the export volume EXP, whereby increasing the tax gap TAG by 1% will lead to a decrease in the export volume by 4.14%.
- This result indicates that a high tax gap, which reflects the difference between what should be collected in taxes and what is actually collected, is negatively related to export performance, although the relationship is not statistically significant. From an economic perspective, the tax gap may reflect weak tax administration and high levels of tax evasion.
- This reduces the state's resources and limits its ability to finance infrastructure and services that support export activity.
- A high tax gap may also create an unfair environment among businesses and lead to distortions in competition, which negatively impacts the performance of the private sector, especially exporters.

- However, the statistically insignificant relationship may indicate that the effect of the tax gap on exports is not direct or is mediated by other intervening factors, such as the institutional environment or the nature of the tax system.
- Error correction limit:
  By estimating the short-term relationship through the error correction model (ECM), which expresses the study variables in the form of a first-order difference filter, such that the error correction term is recent to only one period of time, as an explanatory variable, through which it is possible to know the speed of adaptation of imbalances that occur in the short term to equilibrium in the long term, So if the error correction coefficient has a negative sign with a significant probability of less than 0.05, it indicates that there is a long-term relationship, as the absolute value of the error correction coefficient is considered the speed of restoring the equilibrium state again, and the results of testing the error correction model and the short-term relationship, the error correction limit is equal to Ecm = -0.14 significant and negative at 5%. This indicates that the long-run relationship between financial sustainability variables and exports (EXP) is significant. In other words, it takes approximately 8 iterations for the model to return to its long-run equilibrium value after the shock in the study.
- Short-term analysis:
  The estimation process using the PMG method showed that the relationship between the study variables was not significant, except for the variable of the total public debt to GDP (DEGD), which has an insignificant and inconsistent inverse relationship with the volume of exports (EXP), as increasing the total public debt to GDP (DEGD) by 1% will lead to a decrease in the volume of exports by 2.65%.

4. Analyze the results and test the validity of the hypotheses:

This study sought to measure the impact of financial sustainability on the volume of exports, a standard study using panel models for Algeria and a group of Arab oil countries during the period (2004-2023), relying on panel data through the PANAL-ARDL model, which provides a more comprehensive study considering the integration of the characteristics of the individual dimension of the sample countries in addition to the characteristics of the time dimension, where it was reached:
The results of Hsiao, C. (1986) test proved that there is a random individual effect among the study data.

- Economic evaluation:
  Through the results of estimating the random effect model recorded in the previous equation, it is clear that the following:
- The total public debt to GDP ratio (DEGD) has an inverse relationship that is not significant and inconsistent with economic theory with the volume of exports, as an increase in the total public debt to GDP ratio (DEGD) by 1% will lead to a decrease in the volume of exports by 1.54%.
- The ratio of public revenues to public expenditures (SUGD) has an inverse relationship that is not significant and inconsistent with economic theory with the volume of exports, as increasing the ratio of public revenues to public expenditures (SUGD) by 1% will lead to a decrease in the volume of exports by 9.50%.
- The ratio of oil revenues to public revenues (OIPR) has a significant inverse relationship that is not in accordance with economic theory with the volume of exports, as when the ratio of oil revenues to public revenues (OIPR) is 1%, it will lead to a decrease in the volume of exports by 9.58%.
- The surplus or deficit to GDP (PUPU) parameter has an inverse relationship that is not consistent with economic theory with the volume of exports, as when the surplus or deficit to GDP (PUPU) increases by 1%, it will lead to a decrease in the volume of exports by 9.12%.
- The tax gap parameter TAG has a positive, insignificant relationship that is not in accordance with economic theory with the volume of exports, as increasing the tax gap TAG by 1% will lead to an increase in the volume of exports by 3.10%.

- Statistical evaluation:
- The coefficient of determination shows that R2 = 15%. This means that the variables occurring in exports (EXP) are determined within the model, i.e. they are determined by the variables of the explanatory model, which is a small percentage, while a large percentage remains within the margin of error.
- The Fisher test indicates the overall significance of the model at the 5% level, which means that the explanatory variables as a whole have the ability to explain the change in the dependent variable, the volume of exports (EXP). The Student test also shows us that the independent variables are mostly not significant at the 5% confidence level.
- The Durbin-Watson DW test also indicated the presence of autocorrelation of errors 29DW=0. This means that the errors are auto correlated, making the parameter estimates inconsistent. This means that the model is weak from a standard perspective. Therefore, the model estimated in the static panel data is weak, which allows us to estimate the relationship in both the short and long run.
- The Badroni test proved the existence of a joint integration relationship between the study variables, which confirms the validity of the first hypothesis, which states the existence of a joint integration relationship between the financial sustainability indicators and the volume of exports in Algeria and the group of Arab oil countries during the period (2004-2023).
- The optimal model among the selected models is the Ardl (4.1.1.1.1) panal model, using the (AIC) criterion, where the relationship was estimated for the panal dynamic Battl model using the integrated mean group methodology (POLED MEAN GROUP), for the long and short term in addition to the error correction limit:
- Long-term analysis:
  The ratio of total public debt to GDP (DEGD) has an inverse relationship that is not significant and inconsistent with economic theory with the volume of exports (EXP), whereby an increase in the ratio of total public debt to GDP (DEGD) by 1% will lead to a decrease in the volume of exports by 1.16%, this can be explained by several economic and circumstantial factors. Theoretically, public debt is not supposed to have a direct and negative impact on exports. Rather, it depends on how the debt is used. If public debt is directed toward financing investment spending in infrastructure and facilities aimed at supporting production and exports, This may contribute positively to stimulating exports, but in the case of a well-studied economy, public debt may be largely directed toward covering the current account deficit or unproductive consumer spending, which does not translate into a real boost to export capacity. Furthermore, high public debt may contribute to creating inflationary pressures or raising interest rates, weakening the competitiveness of domestic products in foreign markets.
- In addition, the statistically insignificant relationship suggests that this effect may be weak or unstable, and may be affected by other factors not included in the model, such as the exchange rate, the efficiency of trade policies, or the quality of institutions.
- The parameter of the ratio of public revenues to public expenditures (SUGD) has a significant positive relationship with the volume of exports, as increasing the ratio of public revenues to public expenditures (SUGD) by 1% will lead to an increase in the volume of exports by 2.42%.
- This positive correlation reflects that improving the efficiency of public finances through increasing the ratio of revenues to expenditures enhances the country's financial stability and provides a wider margin for financing investments in productive sectors and infrastructure that support export activity, The increase in revenues compared to expenditures may indicate the presence of sound financial policies that reduce reliance on public debt, which increases general economic confidence, improves the business environment, and encourages investors and exporters to expand. Also, this indicator may be a reflection of improved overall economic performance, which is often linked to increased productivity and competitiveness in the external sector."
- The ratio of oil revenues to public revenues (OIPR) has a significant positive relationship with the volume of exports, where a ratio of oil revenues to public revenues (OIPR) of 1% will lead to an increase in the volume of exports by 5.76%. This strong positive relationship indicates the great

importance that oil exports occupy in the structure of total exports. Especially in a rentier economy that relies primarily on the hydrocarbon sector as the primary source of public revenue. The higher the percentage of oil revenues, the more oil exports, which typically constitute the largest portion of national exports. Furthermore, increased oil revenues may contribute to providing financial liquidity for the government, which can be used to improve infrastructure and logistics services. This, in turn, enhances the economy's ability to export. However, on the other hand, this correlation may also indicate the fragility of economic diversification, as exports remain subject to fluctuations in global oil prices.

- The surplus or deficit to GDP (PUPU) parameter has a significant positive relationship, consistent with economic theory, with the volume of exports, as when the surplus or deficit to GDP (PUPU) increases by 1%, it will lead to an increase in the volume of exports by 5.76%.
- This correlation reflects that improving the financial position of the governments in the study sample, whether through reducing the deficit or achieving a general budget surplus, contributes to enhancing the economy's ability to export. When the budget balance improves as a percentage of GDP, the state's ability to invest in infrastructure, develop productive sectors, and stimulate export sectors increases through support or an improved economic climate.
- A general budget surplus often reflects effective financial management and economic stability, which increases confidence in the economy and enhances its external competitiveness. This is consistent with the theoretical view that links financial stability with improved external economic performance.
- The tax gap parameter TAG has an inverse and insignificant relationship with the export volume EXP, whereby increasing the tax gap TAG by 1% will lead to a decrease in the export volume by 4.14%.
- This result indicates that a high tax gap, which reflects the difference between what should be collected in taxes and what is actually collected, is negatively related to export performance, although the relationship is not statistically significant. From an economic perspective, the tax gap may reflect weak tax administration and high levels of tax evasion, which reduces state resources and limits its ability to finance infrastructure and services supporting export activity.
- A high tax gap may also create an unfair environment among businesses and lead to distortions in competition, which negatively impacts the performance of the private sector, especially exporters.
- However, the statistically insignificant relationship may indicate that the effect of the tax gap on exports is not direct or is mediated by other intervening factors, such as the institutional environment or the nature of the tax system.
- Error correction limit:
  By estimating the short-term relationship through the error correction model (ECM), which expresses the study variables in the form of a first-order difference filter, such that the error correction term is recent to only one period of time, as an explanatory variable, through which it is possible to know the speed of adaptation of imbalances that occur in the short term to equilibrium in the long term, so if the error correction coefficient has a negative sign with a significant probability of less than 0.05, it indicates that there is a long-term relationship, as the absolute value of the error correction coefficient is considered the speed of restoring the equilibrium state again, and the results of testing the error correction model and the short-term relationship, the error correction limit is equal to Ecm = -0.14 significant and negative at 5%,this indicates that the long-term relationship between financial sustainability variables and exports (EXP) is significant. In other words, it takes the model approximately 8 times to return to its long-term equilibrium value after the shock in the study.
- Short-term analysis:
  The estimation process using the PMG method showed that the relationship between the study variables was not significant, except for the variable of the total public debt to GDP (DEGD), which has an insignificant and inconsistent inverse relationship with the volume of exports (EXP),

as increasing the total public debt to GDP (DEGD) by 1% will lead to a decrease in the volume of exports by 2.65%.

- This confirms the validity of the second hypothesis, which states that there is a significant effect between the financial sustainability indicators and the volume of exports in Algeria and the group of Arab oil countries during the period (2004-2023).

General conclusion:

The results of this study revealed a variation in the nature of the relationship between a set of macro-financial variables and export volume, reflecting the complexity of the economic and financial structure of the country under study. Some indicators, such as the ratio of general revenues to expenditures (SUGD) and the ratio of oil revenues to general revenues (OIPR), The general budget balance as a percentage of GDP (PUPU) has a positive and significant relationship with exports, which reinforces the theoretical proposition that improving the state's financial position, whether through increasing revenues or achieving a budget surplus, has a positive impact on external economic performance, especially by increasing investment spending, providing a stable financial environment, and enhancing the competitiveness of producers and exporters.

These results demonstrate the importance of prudent fiscal policy as an indirect tool for stimulating exports, particularly in oil-rent-dependent economies, where oil revenues play a dual role: as a source of financing and as a key component of the export structure. This explains the strong effect of the OIPR parameter on export volume.

In contrast, the study found inverse and insignificant relationships between the public debt-to-GDP ratio (DEGD) and the tax gap (TAG) and export volume, raising questions about the effectiveness of debt management and the efficiency of the tax system. Accumulating public debt without directing it toward productive or export activities may have negative effects, whether by reducing fiscal space or creating economic pressures such as inflation or rising interest rates, the tax gap also reflects an imbalance in domestic resource mobilization, leading to a decline in the state's ability to invest in growth sectors and access foreign markets.

The insignificant relationship between these variables suggests the presence of intervening factors that may weaken their direct impact, such as institutional efficiency, the effectiveness of public spending, the transparency of the financial system, and the level of economic governance. This indicates that the impact lies not only in the size of the financial indicator, but also in how it is employed to serve development and production.

Accordingly, the study recommends formulating balanced financial policies that take into account growth and competitiveness priorities, through:

• Rationalizing expenditures and directing them toward productive and logistical infrastructure.
• Reducing the tax gap by expanding the tax base and improving compliance.
• Adopting public debt strategies based on criteria of economic efficiency and sustainability.
• Diversifying sources of revenue and exports to reduce dependence on the hydrocarbon sector.

Achieving sustainable export growth is not only linked to quantitative financial variables, but also to the effectiveness of public policies and the depth of economic reforms, which must constitute the core of the strategic vision for the next phase.

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