The Impact of Export Volatility on Economic Growth in Algeria during 1992-2016: An Econometric Study

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Abstract

Objectives: The issue of export volatility in the economies of less developed countries (LDCs) is a significant topic of debate in economic literature. This paper aims to investigate the potential effect of export volatility on economic performance in Algeria.

Methods: The study utilizes an econometric model to estimate the impact of export volatility on economic growth in Algeria for the period 1992-2016. Additionally, another regression model is used to analyze the effects of fluctuations in export prices and quantities on economic growth in Algeria.

Results: The findings show that there is no significant relationship between the export instability index and real GDP.

Conclusion: The study concludes that fluctuations in the prices and quantities of exports do not influence Algeria's real GDP. Policymakers should reduce the dependency of the export sector on oil products and improve industrial performance in Algeria. Implementing price stabilization schemes and allocating more oil precautionary funds are also needed to mitigate any possible damaging effects of export volatility on Algeria's economy in the future.

Keywords: Export Volatility, Economic Growth, GDP, Algeria.

أثر تذبذب الصادرات على النمو الاقتصادي في الجزائر خلال الفترة 1992-2016: دراسة قياسية

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ملخّص

الأهداف: تُعدّ مشكلة تذبذب الصادرات في اقتصادات البلدان الأقل نمواً موضوعا مُهمّاً في الأدبيات الاقتصادية ، وتهدف هذه الورقة إلى دراسة التأثير المحتمل لتذبذب الصادرات على النمو الاقتصادي في الجزائر.

المنهجية: تستخدم الدراسة نموذج الاقتصاد القياسي لتقدير تأثير تذبذب الصادرات على النمو الاقتصادي في الجزائر للفترة 1992-2016، إضافة إلى ذلك، تمّ استخدام نموذج انحدار آخر لتحليل آثار التذبذبات في أسعار الصادرات وكمياتها على النمو الاقتصادي في الجزائر.

النتائج: أظهرت النتائج أنه لا توجد علاقة ذات دلالة إحصائية بين مؤشر عدم استقرار الصادرات والناتج المحلي الإجمالي الحقيقي، وهذا يعني أنّ تذبذب الصادرات لا يُشكّل عقبة أمام الأداء الاقتصادي في الجزائر.

الخلاصة: كشفت الدراسة أنّ التذبذبات في الأسعار وكميات الصادرات لا تؤثر على الناتج المحلي الإجمالي الحقيقي في الجزائر. أوصت الدراسة بأهمية توجه صانعي السياسات إلى تقليل اعتماد قطاع التصدير على المنتجات النفطية وتحسين الأداء الصناعي في الجزائر، إضافة إلى أهمية العمل على تنفيذ خطط تثبيت الأسعار وتخصيص المزيد من الأموال الاحتياطية للنفط للحدّ من الآثار الضارة المحتملة لتذبذب الصادرات على الأداء الاقتصادي للجزائر في المستقبل.

الكلمات الدالة: تذبذب الصادرات، النمو الاقتصادي، الناتج المحلي الإجمالي، الجزائر.

1. INTRODUCTION

Like many developing countries, the export sector represents an essential source of income in Algeria. According to World Bank data, exports of goods and services constituted almost 31.5% of Algeria's GDP during the period 1992-2016. A stable flow of export earnings is necessary for continued steady growth in Algeria's economy. In contrast, volatility in export revenues can impair import capacity (Hanom, 2010), reduce employment opportunities, lower the rate of return-on-investment projects, and increase both internal and external imbalances (Bilquees and Mukhtar, 2011).

Algeria's export sector is heavily dependent on oil products; fuel products represented almost 97.2% of total exports from 1992 to 2016 (Traore and Saqfalhait, 2022). This dependence on fuel exports exacerbates fluctuations in export earnings because the prices of these products are volatile in world markets.

This paper seeks to investigate whether export volatility impacts economic performance in Algeria. Specifically, does export volatility reduce economic performance in Algeria? Do fluctuations in the prices and volumes of exports influence economic performance in Algeria?

2. THEORETICAL BACKGROUND

The role of foreign trade in the development process has received notable attention in the literature. International trade is not only an engine of growth in Least Developed Countries (LDCs) but also a means of maximizing production and optimizing the allocation of resources. It offers large markets and stimulates the use of advanced technology and innovation for each country (Niranjan Kumar Singh, 2005). Among the major problems that prevent LDCs from achieving rapid and stable economic growth is the volatility in their export earnings (Macbean, 1966). A considerable body of literature exists on the effect of export volatility on the economic performance of LDCs (see for example Macbean (1966), Voivodas (1974), Park (1974), Moran (1983), Gyimah-Brempong (1991), and Larsen (2002)).

This section explains two different schools of thought on the impact of export volatility. The first is the conventional pessimistic view, which states that export volatility has a deleterious effect on the economic growth of LDCs (Chaudhary and Naveed, 2003). The second school of thought represents the optimistic view. According to proponents of this view, export volatility has a growth-enhancing effect rather than a growth-inhibiting effect in LDCs (Benmoumen, 1989).

2.1 The Pessimistic View

Many studies have been conducted to examine the unfavorable impact of export volatility on the economic performance of LDCs. A significant portion of these studies suggests that sharp fluctuations in export earnings have a substantial adverse effect on the overall growth of underdeveloped and developing countries. Examples of these studies include Glezakos (1973), Voivodas (1974), Gyimah-Brempong (1991), Love (1992), Devkota (2004), Sinha (1999), and Larsen (2002).

Advocates of the pessimistic view argue that export volatility impedes economic growth in several ways. First, it causes short-run domestic uncertainty, which reduces the productivity and efficiency of investment (Whyte, 2017). Second, export volatility leads to instability in government revenues, which in turn destabilizes government expenditures, ultimately harming economic growth (Lim, 1987). Third, domestic prices are also expected to be influenced by volatility in export earnings; for instance, export volatility may stimulate inflation (Macbean, 1966; Sinha, 1999). All these disadvantageous effects contribute to negative economic growth in LDCs.

2.1.1 Export Volatility and Investment

Some economic researchers confirm that export volatility harms the growth rate of GDP. According to their arguments, export volatility influences a country's economic growth indirectly by reducing investment. Export volatility is thought to have adverse consequences on both the level and efficiency of investment (Ghirmay et al., 1999).

Macbean (1966) explains that export volatility harms entrepreneurs due to the uncertainty and risks it causes. It makes estimating the expected return on investment very difficult; the more volatile the export earnings, the harder it becomes to estimate expected returns. As a result, planning future production becomes more challenging (Malanga, 1974). This negative impact on entrepreneurs is also due to the limitations on import capacity (Hanom, 2010).

High levels of investment in developing countries play a vital role in their economic growth. To achieve these high levels, capital goods must be imported from the world market. The purchase of these goods depends on the availability of foreign currencies, which come mainly from export receipts (El-Samhouri, 1990). LDCs do not have large reserves and face constraints on foreign borrowing. Therefore, any decline in export earnings must be accompanied by restrictions on both public and private imports. These restrictions will delay the purchase of capital goods or raw materials required for investment (Mohamed, 1983).

The decline in the import of capital goods implies a decrease in capital accumulation and, consequently, a reduction in the level of investment in a given country (Medo, 2012). This decline in investment rates will have unfortunate implications for the economic growth of LDCs.

2.1.2 Export Volatility and Government Revenues

Another channel through which export volatility affects economic growth is the instability in government revenues (Koomsup, 1978). In LDCs, export volatility has a significant impact on government revenues. In these countries, tariffs and various taxes on foreign trade constitute a large portion of government revenues (Mohamed, 1983). Because LDCs depend heavily on foreign trade, large fluctuations in their export revenues induce volatility in government revenues. This volatility leads to a decline in fiscal spending, which negatively impacts the economies of these countries (El-Samhouri, 1990).

2.1.3 Export Volatility and Inflation

Theoretically, the volatility of export earnings also causes variations in a country's GDP by adversely affecting the domestic price level (Saiers, 1970). If export volatility is followed by similar fluctuations in incomes, the demand for domestically produced goods and services is expected to move in the same direction. Since these goods are primarily agricultural and housing products, their short-term supply elasticity is very low. Therefore, any increase in demand for these goods will lead to significant increases in the inflation rate. Conversely, a sharp decline in export receipts will reduce domestic demand and, hence, decrease the price level (Macbean, 1966).

Export volatility may result in variations in the price level through different channels. For example, Park (1974) states that during a recession, a fall in export receipts accompanied by a balance of payments deficit would stimulate currency devaluation or the imposition of import constraints. Both factors may contribute to increased inflationary pressure on prices. Conversely, during a period of expansion, exporters' revenues may increase, inducing higher demand. In this scenario, national authorities may struggle to mitigate inflation.

Taxes and duties are substantial sources of government revenue in many LDCs. Therefore, volatility in export receipts will induce fluctuations in government expenditures and development projects. If a country attempts to support its national expenditures and development plans through budget deficits, it will likely face higher inflation (Pupphavesa, 1980).

2.2 The Optimistic View

In contrast to the proponents of the pessimistic view on export volatility, other studies highlight the positive relationship between export volatility and economic performance (for example, see Knudsen and Parnes (1975), Yotopoulos and Nugent (1976), Savvides (1984)). The arguments of these studies are based on the permanent income hypothesis of consumption. According to this hypothesis, the marginal propensity to consume from the transitory component of income is lower than that of permanent income. This means that when transitory income is high (as a result of export volatility), the saving and investment percentages will expand; consequently, the growth of income will be larger (Yotopoulos and Nugent, 1976). Based on these studies, any policies that seek to decrease export volatility in a given country could be detrimental to its economic growth.

3. LITERATURE REVIEW

One of the main subjects that prevail in the trade and development literature is the volatility of export earnings. Many studies have investigated the relationship between export volatility and economic growth in developing countries (see Macbean (1966), Glezakos (1973), Yotopoulos and Nugent (1976), Gyimah-Brempong (1991), Love (1992), and Sinha (1999)). This section is divided into two parts: first, empirical studies that support the undesirable effect of export volatility on economic growth; second, studies that find a positive relationship between export volatility and economic growth. Additionally, studies that do not find any significant link between these variables are discussed.

3.1 The Negative Relationship between Export Volatility and Economic Growth

The undesirable effect of export volatility on economic growth in developing countries was studied by Glezakos (1973). His study responded to the findings of Macbean (1966), which indicated a significant relationship between export volatility and economic growth. Glezakos used regression analysis to test the impact of export volatility (defined as the arithmetic mean of the absolute values of the yearly changes in a time series corrected for the trend) on the income growth rate of both LDCs and developed countries (DCs). He also compared the magnitude of export price and export quantity volatility impacts on economic growth. His findings indicated that the negative impact of export volatility was only significant in LDCs. Additionally, he showed that the effect of export quantity volatility was less than that of export price volatility for both sets of countries, suggesting that price volatility has a more damaging effect on economic growth.

Gyimah-Brempong (1991) used a neoclassical production function to investigate the association between export volatility and economic growth in Sub-Saharan African countries. He calculated three indices to measure export volatility: the coefficient of variation in exports between countries, a measure similar to that used by Glezakos (1973), and the mean square of the ratio of actual export receipts to trend earnings. After controlling for other variables, his cross-sectional data analysis indicated that, regardless of the measure used, the economic growth of Sub-Saharan African countries is negatively affected by export fluctuations. He concluded that these countries should work to lessen the negative effects of volatility in export earnings.

The long-run association between export volatility and economic growth is further explored in the works of Medo (2012) and Oladipo (2017). These studies used different techniques to estimate a neoclassical production function, with GDP as the dependent variable and total exports and an export volatility index as additional independent variables. Medo used the Engle-Granger approach to estimate annual time series data for the period 1981-2011, while Oladipo applied the Error Correction Model (ECM) to estimate quarterly data for the period 1970-2011. Both studies support the pessimistic

view about export volatility. Medo found that export volatility has a negative and significant effect on Ethiopia's GDP. Oladipo stated that a 1% increase in export volatility leads to a 0.35% decrease in Nigeria's GDP. Both studies recommended diversifying the export sector by increasing the share of exports in which these countries have comparative advantages.

3.2 The Positive Relationship between Export Volatility and Economic Growth

The positive impact of export volatility on economic growth was demonstrated in the works of Yotopoulos and Nugent (1976), Savvides (1984), and Alkhatib (2022).

Yotopoulos and Nugent (1976) aimed to investigate whether export volatility hindered or stimulated economic growth across 38 countries from 1949 to 1967. Using regression analysis, they examined the relationship between the ratio of capital to GDP and total exports with various measures of export volatility. Their results indicated different outcomes based on the volatility measure used. When employing squared deviations from an exponential trend, they found a negative correlation between investment and GDP growth rates, though not statistically significant. In contrast, the use of the transitory index[1] of export volatility suggested a positive and significant association between export volatility and both investment and economic growth. They argued that countries experiencing high instability in export earnings tend to witness higher growth rates in investment and income, consistent with the permanent income hypothesis of consumption. This hypothesis posits that the marginal propensity to save from transitory income is higher than from permanent income, thereby expanding savings and investment during periods of high transitory income (Yotopoulos and Nugent, 1976).

Savvides (1984) challenged the notion that export volatility hinders economic growth in LDCs. Building on Glezakos's (1973) research, Savvides analyzed export earnings and real GDP per capita data from 1967 to 1977. He categorized his sample into developed countries (DCs) and LDCs, excluding ten countries whose import capabilities were independent of exports. His cross-sectional regression analyses indicated that export volatility increased economic growth in LDCs, contradicting Glezakos's findings.

Macbean (1966) conducted a study that did not find a significant link between export earnings volatility and economic growth. His analysis, aimed at demonstrating the negative impact of short-run fluctuations in export receipts on economic performance in underdeveloped countries, failed to establish a clear adverse effect of export volatility. Using simple correlation analysis across 22 underdeveloped countries, Macbean found a negative correlation between trade instability and economic growth, but it lacked statistical significance. He concluded that short-term export volatility might limit the capacity of underdeveloped countries to achieve high economic growth levels.

Moran (1983) also explored the effects of export volatility across 30 countries from 1954 to 1975. His study indicated that uncertainty stemming from export volatility did not significantly impact economic growth. Moran decomposed export volatility into price and quantity components and argued that while price volatility stimulated savings rates, quantity fluctuations discouraged savings. Over the long term, these effects tended to offset each other, resulting in no overall impact on economic growth. Moran observed variations in the effects of export volatility across different time periods: he found a negative and significant impact on savings and economic growth from 1954 to 1965, which became statistically insignificant in subsequent periods. He attributed this to the reinforcing and counterbalancing effects of price and quantity volatility across different economic phases.

[1] Which is defined as the normalized variance of the transitory income component of export earnings, see Yotopoulos and Nugent (1976), p 333.

Chaudhary and Qaisrani (2002) analyzed the multidimensional effects of export volatility on economic growth in Pakistan from 1972 to 1994. Their study concluded that Pakistan's economic growth was not significantly affected by export volatility during this period. They rejected the hypothesis that uncertainty from export volatility unfavorably impacts investment, causes inflation, or reduces economic performance in developing countries. Chaudhary and Qaisrani attributed Pakistan's resilience to maintaining foreign exchange reserves and import capacity, which mitigated the negative effects of export volatility on economic growth.

4. DATA AND METHODOLOGY

This section aims to investigate the impact of export volatility in Algeria using a regression model based on annual time series data from 1992 to 2016. Data on Real GDP, total capital formation and its percentage of GDP, total nominal exports, and their ratio to GDP are sourced from annual World Bank publications. The study further decomposes export volatility into two components: fluctuations in export prices and quantities. Another regression model is employed to estimate the effect of these fluctuations on Algeria's economic growth over the specified period. Annual data on export prices and volume indices are also obtained from World Bank statistics. This section begins by describing the models, outlining the methods used for estimation, and concludes with a discussion of the results.

4.1 The Effect of Export Volatility on the Economic Growth of Algeria during the Period of 1992-2016

The study analyzes annual data from 1992 to 2016 using a regression model to explore the relationship between export volatility and economic performance in Algeria. Real Gross Domestic Product (RGDP) serves as the dependent variable and is modeled as a function of several regressors: total real exports (X), total employment (L), real gross capital formation (K), and export volatility (IEREAL).

RGDP, the dependent variable, is a key indicator widely used to assess the health of national and global economies (IMF, 2018). It represents GDP adjusted for inflation and reflects the volume level of economic output. Constant price estimates of GDP are derived by evaluating the value of all goods and services produced in a given year relative to a base period, typically measured as growth rates compared to the previous year (OECD, 2019).

Total exports (X) are included as an independent variable in the model and are recognized as pivotal for promoting economic growth in Algeria. The literature has extensively tested the export-led growth hypothesis in Least Developed Countries (LDCs), suggesting that export promotion policies effectively stimulate economic development in these nations (Michaely, 1977; Balassa, 1978; Ram, 1987; Salvatore and Hatcher, 1991; Al-Yousif, 1997; Onafowaro and Owoye, 1998). Total real exports are computed using data on total nominal exports and export price indices.

Real gross capital formation (K) and employment (L) are additional independent variables in the model, representing crucial factors of production. Their expected positive coefficients indicate that higher levels of capital and labor contribute to increased income or output (Taban and Aktar, 2008).

Export volatility (IEREAL) is defined as the absolute percentage deviation of actual total commodity export earnings from estimated values of the same commodities. It is calculated using the formula proposed by Tariq and Najeeb (1995):

$$IE_t = \left|\frac{X_t - \hat{X}_t}{\hat{X}_t}\right| * 100 \quad \text{……. (1)}$$

Where: X_t is the actual value of total exports in year t. $\hat{X}_t$ refers to the estimated value of total exports in year t. It can be

measured from the following regression model:

$$X_t = \alpha_0 + \alpha_1 t + U_t \quad \ldots\ldots\ldots (2)$$

Where t is the period, and Ut is the error term. This model eliminates any biases that could appear from time series. It calculates the export volatility indices for each year within the period under study.

IEREAL is included in the model as an explanatory variable to estimate its effect on Algeria's overall economic growth. The primary objective of this paper is to investigate the impact of export volatility on economic growth. Therefore, the study aligns with past empirical research and employs the real values of exports to measure export volatility accurately.

4.1.1 The Model

Based on previous studies (Gyimah-Brempong, 1991; Rashid et al., 2012; Larsen, 2002; Olajide, 2017; Abdelhadi et al., 2019), this study estimates a neoclassical production function that incorporates export volatility as an additional variable. For instance, Abdelhadi et al. (2019) investigated the impact of export volatility on the economic growth of MENA (Middle East and North Africa) countries. They examined the long-run relationship between the export instability index and Gross Domestic Product (GDP), alongside other explanatory variables such as exports, gross fixed capital formation, and population for the period 1990–2016.

The present study estimates the following regression model:

$$RGDP_t = \gamma_0 + \gamma_1 X_t + \gamma_2 L_t + \gamma_3 KTP_t + \gamma_4 IEREAL_t + E_t \quad \ldots\ldots\ldots (3)$$

RGDP denotes real gross domestic product, X represents total real exports, L stands for employment, KTP indicates the share of capital in GDP, IEREAL denotes export volatility, and Et represents the error term. All variables are in logarithmic form (log).

Before estimating the model, ADF, PP, and KPSS tests are conducted to detect unit roots in the time series. The Johansen Cointegration test is employed to determine whether a long-run relationship exists in the model. The FMOLS method is used to estimate the impact of export volatility on economic growth in Algeria for the period 1992-2016. Additionally, the Jarque-Bera test is utilized to assess the normality of the residuals in the model.

4.1.1.1 Unit Root Test

The results of unit root tests for the variables of the model are presented in Table 1 and Table 2.

Table 1. The ADF and PP Unit Root Tests for the Variables of the Model

variable	ADF test ((the null hypothesis time series have unit root))						Perron test (the null hypothesis time series have unit root)						Description of results
	in level			in First difference			in level			in First difference			
	ADFr t-statistic		Test c.v	ADF t-statistic		Test c.v	Adj. t-Stat		Test c.v	Adj. t-Stat		Test c.v	
IEREAL	with constant	-3.08	-2.99	with constant	-4.73	-3.01	with constant	-2.992	-2.992	with constant	-7.72	-2.99	IEREAL is stationary at level
X	with constant	-3.09	-3.01	with constant	-2.03	-3.02	with constant	-1.542	-2.992	with constant	-4.61	-2.99	X is stationary at level with ADF and stationary at first difference with PP
L	with constant	0.3620	-3.15	with constant	-4.65	-3.07	with constant	-1.115	-3.005	with constant	-7.02	-3.02	L is stationary at first difference
KTP	with constant	-0.39	-2.99	with constant	-4.76	-2.99	with constant	-0.128	-2.992	with constant	-5.11	-2.99	KTP is stationary at first difference
RGDP	with constant	0.880	-2.99	with constant	-4.24	-2.99	with constant	0.6610	-2.992	with constant	-4.24	-2.99	RGDP is stationary at first difference

Source: Prepared by the researchers

Table 2. The KPSS Unit Root Test for the Variables of the Model

variable	KPSS unit root test (the null hypothesis time series are stationary)						Description of results
	in level			in First difference			
	LM-Stat.		Test c.v	LM-Stat.		Test c.v	
IEREAL	with constant	0.059149	0.463	with constant	0.318300	0.463	IEREAL is stationary at level
X	with constant	0.207913	0.463	with constant	0.215556	0.463	X is stationary at level
L	with constant	0.699789	0.463	with constant	0.143424	0.463	L is stationary at first difference
KTP	with constant	0.617136	0.463	with constant	0.324127	0.463	KTP is stationary at first difference
RGDP	with constant	0.723333	0.463000	with constant	0.206250	0.463000	RGDP is stationary at first difference

Source: Prepared by the researchers

As shown in these tables, the ADF, PP, and KPSS tests indicate that L, KTP, and RGDP are stationary at first difference. According to the ADF and KPSS tests, X is stationary at level. IEREAL is also stationary at level, as indicated in the results of all unit root tests. From these results, one concludes that all the variables of the model are stationary at the first difference, except for IEREAL and X, which are considered as I (0) variables.

4.1.1.2 Multicollinearity Test

The correlation matrix presented in Table 3 suggests collinearity between variables L (employment) and KTP (share of capital in GDP). To ensure multicollinearity between L and KTP does not affect the model, L is regressed against the other explanatory variables, and the results are detailed in Table 4. The analysis confirms the absence of significantmulticollinearity between L and KTP, as indicated by a Variance Inflation Factor (VIF) below 10 (Joshi, 2012).

Table 3. The Correlation Matrix between the Explanatory Variables of the Model

	X	L	KTP	IEREAL
X	1	0.299207	-0.1252	-0.01995
L	0.299207	1	0.80863	-0.06402
KTP	-0.1252	0.80863	1	-0.08423
IEREAL	-0.01995	-0.06402	-0.08423	1

Source: Prepared by the researchers

Table 4. The Regression of L on KTP and the other Explanatory Variables

Dependent Variable: L				
Method: Least Squares				
Sample: 1992 2016				
Included observations: 24				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.73135	3.120519	-0.23437	0.8171
X	0.767037	0.181604	4.223676	0.0004
KTP	1.059583	0.119081	8.897994	0.0
IEREAL	0.004975	0.028705	0.173295	0.8642
R-squared	0.817069	Mean dependent var		15.82357
Adjusted R-squared	0.789629	S.D. dependent var		0.292125
S.E. of regression	0.133987	Akaike info criterion		-1.03114
Sum squared resid	0.359048	Schwarz criterion		-0.8348
Log likelihood	16.3737	Hannan-Quinn criter.		-0.97905
F-statistic	29.77688	Durbin-Watson stat		0.693352
Prob(F-statistic)	0.0	VIF		5.466542

Source: Prepared by the researchers

4.1.1.3 Cointegration Test

The study employed the Johansen cointegration test to examine the existence of a long-run relationship between RGDP and its explanatory variables: L, KTP, X, and IEREAL. As depicted in Table 5, the TRACE test indicates the presence of two cointegrating equations in the model.

Table 5. The Cointegration Test for the Model

Sample (adjusted): 1994 2016				
Included observations: 20 after adjustments				
Trend assumption: Linear deterministic trend				
Series: RGDP X L KTP IEREAL				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.86374	88.57499	69.81889	0.0008
At most 1 *	0.720348	48.71117	47.85613	0.0415
At most 2	0.486087	23.22696	29.79707	0.2351
At most 3	0.34188	9.912928	15.49471	0.2875
At most 4	0.074368	1.545575	3.841466	0.2138
Trace test indicates 2 cointegratingeqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Source: Prepared by the researchers

4.1.1.4 The Estimation of the Model

Previously, it was established that IEREAL, L, KTP, X, and RGDP are integrated at different orders and are cointegrated. The FMOLS method is employed to estimate the long-run relationship in the model. Developed by Phillips (1995), this method provides optimal estimates for cointegrating regressions. FMOLS adjusts Ordinary Least Squares (OLS) to address

serial correlation effects and endogeneity in regressors arising from cointegration (Phillips, 1995). It is applicable to models with both I(1) and I(0) regressors. The FMOLS estimation results are presented in Table 6.

Table 6. The Estimation of the Model

Dependent Variable: RGDP				
Method: Fully Modified Least Squares (FMOLS)				
Sample (adjusted): 1993 2016				
Included observations: 22 after adjustments				
Cointegrating equation deterministics: C				
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
X	0.139887	0.067057	2.086096	0.0523
L	0.673673	0.065734	10.24846	0
KTP	0.311001	0.073702	4.219732	0.0006
IEREAL	0.012748	0.007214	1.767287	0.0951
C	4.576745	0.816386	5.606106	0
R-squared	0.978608	Mean dependent var		18.70637
Adjusted R-squared	0.973574	S.D. dependent var		0.264827
S.E. of regression	0.04305	Sum squared resid		0.031507
Long-run variance	0.001103			

Source: Prepared by the researchers

4.1.1.5 The Goodness of Fit

As depicted in Table 6, the model exhibits a very high R-squared value, indicating that RGDP is effectively explained by its explanatory variables: L, X, KTP, and IEREAL. Additionally, the Jarque-Bera test results, illustrated in Figure 1, suggest that the residuals derived from the model estimations follow a normal distribution. The null hypothesis, asserting normal distribution of residuals, cannot be rejected.

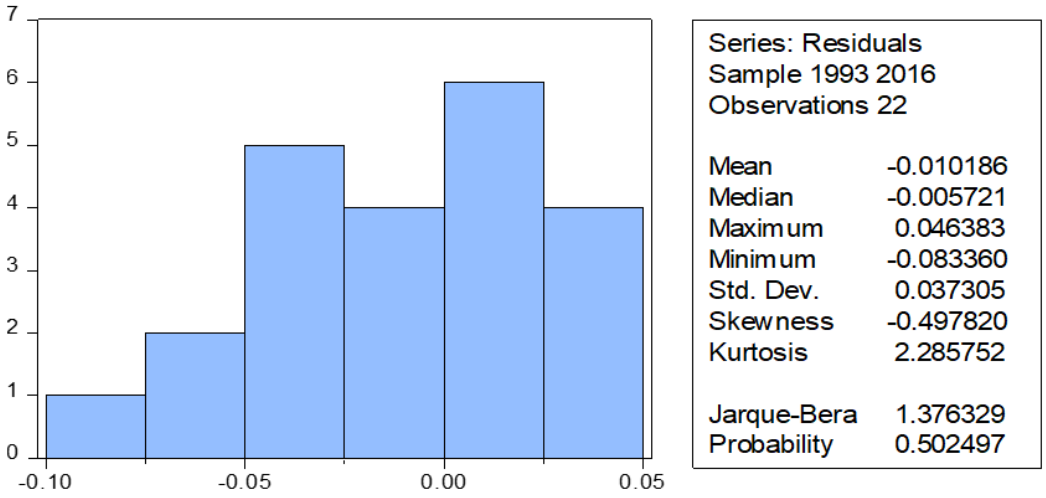

Figure 1. The Normality Test for the Residuals of the Model

Source: Prepared by the researchers

4.1.2 Results and Discussion

The objective of the study is to examine the relationship between export volatility and economic growth in Algeria. Table 6 indicates that the coefficient of IEREAL is not statistically significant. This finding is further supported by the Wald test results for the coefficients of IEREAL, as shown in Table 7.

Table 7. The Wald Test for the Coefficients of IEREAL

Wald Test						
The Model	**variable**	**its coefficient**	**the null Hypothesis**	**Chi-square**		
				Value	**df**	**Probability**
model two	IEREAL	c(4)	c(4)=0	3.123	1	0.077

Source: Prepared by the researchers

Therefore, the study's results do not support the notion that export volatility poses a hindrance to the Algerian economy. This finding aligns with the conclusions drawn by Macbean (1966), Moran (1983), and Chaudhary and Qaisrani (2002).

Algeria's economic growth heavily relies on the export of oil and gas products, which accounted for over 95% of total exports and nearly 30% of GDP in 2019. These exports not only contribute significantly to macroeconomic stability but also help accumulate substantial foreign currency reserves and maintain low debt levels during periods of oil price booms (Central Intelligence Agency, 2019). However, the country's dependence on hydrocarbon exports also increases vulnerability to external economic shocks, which can adversely affect the macroeconomic framework (Sorsa, 1999). Historical financial crises in 1978, 1986, 1994, and 2008, triggered by declines in oil prices, underscore Algeria's susceptibility to these exports (Brika and Mekarssi, 2016). Fluctuations in oil receipts significantly impact government revenues, leading to fiscal imbalances and potentially misaligned fiscal policies during periods of oil price volatility (Andrew Jewell et al., 2014).

Given the finite lifespan of oil (20 years) and gas (55 years) resources, failure to attract sufficient foreign capital could lead to future balance of payments deficits and weaken Algeria's external position. From this discussion, it becomes evident why export volatility has not adversely affected economic growth in Algeria. The negative impact of reduced oil export revenues during recessions appears to counterbalance any growth benefits from increased export earnings during periods of oil price recovery.

Additionally, the management of reserves (Macbean, 1966) and the government's ability to maintain import stability (Limprapat, 1979) are cited as potential reasons for the absence of a negative effect of export volatility on Algeria's economic performance. Windfalls from oil price booms have enabled Algeria to accumulate foreign reserves, which are primarily used for imports rather than productivity enhancements in other sectors or foreign investments. Fluctuations in oil prices result in corresponding fluctuations in export earnings and, consequently, in imports. This volatility in imports may absorb some of the impact on Algeria's RGDP caused by export volatility.

4.2 The Link Between Export Volatility in Prices and Quantities and Economic Growth in Algeria

As export volatility does not impact Algeria's economic growth significantly, the study proceeds by decomposing export volatility into two components: fluctuations in export prices and quantities. This decomposition aims to elucidate how each factor influences economic growth in Algeria. Moran (1983) posited that if both price and quantity volatility reinforce each other, they would harm economic growth in a country. Conversely, if these components offset each other, export volatility would not affect economic growth. This hypothesis is examined in this section of the study, yielding detailed insights into the impact of export volatility.

4.2.1 The Model

The study adopts Moran's (1983) approach to specify the model. To analyze the effects of price and quantity volatilities on economic growth in Algeria from 1992 to 2016, a regression model is constructed using annual data. In this model, Real Gross Domestic Product (RGDP) serves as the dependent variable, influenced by total exports, employment (L), the share of capital in GDP (KTP), and volatilities in export prices and quantities. The relationship is expressed as follows:

$$\mathrm{RGDP_t} = \varphi_0 + \varphi_1 \mathrm{X_t} + \varphi_2 \mathrm{L_t} + \varphi_3\ \mathrm{KTP_t} + \varphi_4 \mathrm{IEP_t} + \varphi_5 \mathrm{IEV_t} + \mathrm{R_1} \quad \ldots\ldots\ldots (4)$$

RGDP denotes real gross domestic product, X represents total real exports, L stands for employment, and KTP signifies the ratio of capital to GDP. IEP and IEV refer to indices measuring volatility in export prices and quantities respectively. The volatility index utilized in section 3-1 is also employed here to quantify IEP and IEV. All variables are logarithmically transformed to estimate RGDP's elasticity with respect to IEP and IEV.

4.2.1.1 Unit Root Test

Table 8 presents the results of the unit root tests for IEP and IEV. The Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests indicate that IEP is stationary at the level, whereas IEV is stationary in first differences, as confirmed by the ADF and Phillips-Perron (PP) tests. Consequently, the model incorporates both stationary and non-stationary time series components. Specifically, IEP, X, and IEREAL are integrated of order 0 (I(0)), while IEV, RGDP, L, and KTP are integrated of order 1 (I(1)) variables.

Table 8. The ADF, PP and KPSS Unit Root Tests for the Variables of the Model

variable	ADF test ((the null hypothesis time series have unit root))						perron test (the null hypothesis time series have unit root)						Description of results
	in level			in First difference			in level			in First difference			
	ADFr t-statistic		Test critical values	ADF t-statistic		Test critical values	Adj. t-Stat		Test critical values	Adj. t-Stat		Test critical values	
IEP	with constant	-3.1016	-2.998	with constant	-4.62	-3.005	with constant	-1.7116	-2.992	with constant	-3.41	-2.998	IEP is stationary at level with ADF test and but stationary at first difference with PP test
IEV	with constant	-2.9489	-2.992	with constant	-5.9	-2.998	with constant	-2.9489	-2.992	with constant	-6.08	-2.998	IEV is stationary at first difference

variable	KPSS unit root test (the null hypothesis time series are stationary)						Description of results
	in level			in First difference			
	LM-Stat.		Test critical values	LM-Stat.		Test critical values	
IEP	with constant	0.232686	0.463	with constant	0.307510	0.463	IEP is stationary at level
IEV	with constant	0.105442	0.463	with constant	0.112263	0.463	IEV is stationary at level

Source: Prepared by the researchers

4.2.1.2 Multicollinearity Test

The correlation matrix presented in Table 9 displays the correlation coefficients among the explanatory variables. None of these coefficients exceed 0.8, except for the correlation between L and KTP. Additionally, as indicated in Table 10, the Variance Inflation Factor (VIF) obtained from regressing L on the other explanatory variables is approximately 4.1, which is below the threshold of 10. This result indicates that these explanatory variables are not collinear. Therefore, the model can be estimated without encountering issues of multicollinearity.

Table 9. The Correlation Matrix for the Model

	X	L	KTP	IEP	IEV
X	1	0.121702	-0.13399	-0.00768	0.253559
L	0.121702	1	0.804363	0.088842	-0.1655
KTP	-0.13399	0.804363	1	0.361519	-0.21995
IEP	-0.00768	0.088842	0.361519	1	-0.06009
IEV	0.253559	-0.1655	-0.21995	-0.06009	1

Source: Prepared by the researchers

Table 10. The Regression of L on the other Explanatory Variables

Dependent Variable: L				
Method: Least Squares				
Sample: 1992 2016				
Included observations: 25				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.216198	1.043308	0.207224	0.8379
KTP	0.321077	0.04283	7.496477	0
X	0.134981	0.061328	2.200977	0.0396
IEP	-0.01533	0.007508	-2.04201	0.0546
IEV	-0.00367	0.010029	-0.36551	0.7186
R-squared	0.753812	Mean dependent var		3.54744
Adjusted R-squared	0.704575	S.D. dependent var		0.081614
S.E. of regression	0.04436	Akaike info criterion		-3.2161
Sum squared resid	0.039356	Schwarz criterion		-2.97233
Log likelihood	45.20128	Hannan-Quinn criter.		-3.14849
F-statistic	15.30969	Durbin-Watson stat		1.164852
Prob(F-statistic)	0.000007	VIF		4.061936

Source: Prepared by the researchers

4.2.1.3 Cointegration Test

The results of the Johansen Cointegration test presented in Table 11 confirm the presence of a long-run relationship in the model. According to the Trace test, two cointegrating vectors exist between RGDP, X, L, KTP, IEP, and IEV.

Table 11. The Cointegration Test for the Model

Sample (adjusted): 1994 2016				
Included observations: 23 after adjustments				
Trend assumption: Linear deterministic trend				
Series: RGDP X L KTP IEP IEV				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
At most 1 *	0.720419	73.90165	69.81889	0.0227
At most 2	0.656701	44.58899	47.85613	0.0982
At most 3	0.405623	19.99847	29.79707	0.423
At most 4	0.288312	8.032905	15.49471	0.4619
At most 5	0.0091	0.210247	3.841466	0.6466
Trace test indicates 2 cointegratingeqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: Prepared by the researchers

4.2.2 Results and Discussion

Based on the DOLSE method, the study estimates the long-run effects of IEP and IEV on RGDP. The results of this estimation are presented in Table 12.

Table 12. The Estimations of the Model

Dependent Variable: RGDP				
Method: Fully Modified Least Squares (FMOLS)				
Sample (adjusted): 1993 2016				
Included observations: 24 after adjustments				
Cointegrating equation deterministics: C				
Long-run covariance estimate (Prewhitening with lags = 1, Bartlett kernel,Newey-West fixed bandwidth = 3.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.58784	0.125623	4.679408	0.0002
L	0.921016	0.40136	2.294739	0.034
KTP	0.793386	0.152189	5.213173	0.0001
IEP	0.00734	0.015033	0.488221	0.6313
IEV	0.010585	0.018016	0.587491	0.5642
C	2.75031	1.908856	1.440816	0.1668
R-squared	0.897508	Mean dependent var		18.70074
Adjusted R-squared	0.869038	S.D. dependent var		0.253975
S.E. of regression	0.09191	Sum squared resid		0.152055
Long-run variance	0.006205			

Source: Prepared by the researchers

As indicated in Table 12, the data fits well as evidenced by the high R-squared for the model estimate. Furthermore, the Jarque-Bera test results depicted in Figure 2 confirm that the residuals of both models follow a normal distribution.

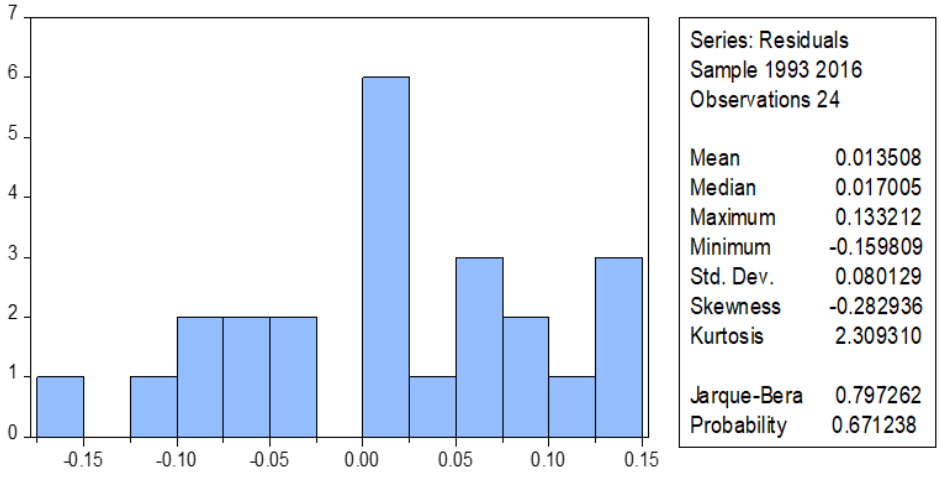

Figure 2. The Normality Test for the Residuals of the Model

Source: Prepared by the researchers

The results of the model estimation indicate that the volatilities in export prices and quantities have no significant impact on Algeria's RGDP. These findings align with those of Belaid (1998), who similarly found no significant effects of price and quantity volatilities on economic growth in Libya from 1971 to 1994. This consistency helps explain why export volatility does not influence Algeria's real GDP. Specifically, the volatilities in export prices and quantities have shown no discernible effect on Algeria's economic performance.

Algeria's economy heavily relies on the growth of oil export revenues, which are determined by global oil prices and their volatility. Increases in oil prices generally bolster Algeria's economic performance, while declines weaken it. However, over the period from 1992 to 2016, the fluctuation in export prices did not significantly affect economic growth, as indicated by the results in Table 12.

In 2017, Algeria's petroleum and other liquids production averaged more than 1.6 million barrels per day, with the country exporting only 580,000 barrels per day of crude oil and condensate (U.S. Energy Information Administration, 2019). Given the country's vast size, its oil production capacity is relatively low, and domestic consumption of oil and gas exceeds export quantities, highlighting Algeria's limited export capacity. Chapter four of this study also found that export quantities did not contribute significantly to overall export volatility in Algeria. Consequently, fluctuations in export quantities had no significant impact on Algeria's economic growth from 1992 to 2016.

5. CONCLUSION

This paper aims to explore the influence of export volatility on economic performance in Algeria. Using annual data from 1992 to 2016, the study employs multiple regression models to investigate this relationship. Additionally, another regression model examines whether fluctuations in export prices and quantities affect economic growth in Algeria. The key findings of this study are summarized as follows:

1. Export volatility does not diminish Algeria's economic performance. There is no significant relationship between the export volatility index and real GDP. This absence of a link can be explained by the counterbalancing effects of oil export receipts during recessionary and boom periods in oil prices, as well as the use of reserves for imports.
2. Fluctuations in both export prices and quantities have no significant effect on economic growth in Algeria. The robust impact of these determinants is not statistically supported, indicating an insignificant relationship between export volatility and economic growth.

The results suggest that export volatility did not significantly impact Algeria's real GDP, implying that it did not hinder economic performance. Therefore, allocating excessive resources to mitigate this issue would be unwarranted. However, policymakers should remain vigilant about potential adverse effects of export volatility on the Algerian economy in the future. Algeria should formulate export promotion strategies aimed at increasing the share of non-fuel exports. These policies should reduce Algeria's reliance on oil product exports, thereby mitigating macroeconomic instability and shocks arising from oil price volatility.

A successful diversification policy in Algeria should create a favorable business environment to attract more private and foreign direct investment. This approach would help reduce dependence on oil exports and enhance productivity in alternative sectors.

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