The Effect of Tax Revenues on Economic Growth in Algeria: A Quantile ARDL Approach

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Abstract

The present study investigates the influence of tax revenues on economic growth in Algeria from 1970 to 2023 using the Quantile ARDL Approach. Specifically, it examines the effects of petroleum tax revenues (PTR), regular tax revenues (RTR), and non-tax revenues (NTR) on GDP growth. The findings highlight that PTR consistently and significantly enhances GDP growth across all sectors, underscoring the critical role of Algeria's hydrocarbons sector in driving economic expansion. Conversely, RTR demonstrates a positive impact on GDP growth in most sectors. However, NTR exhibits a negative influence on GDP growth across all sectors, suggesting potential inefficiencies in stimulating economic activity compared to tax revenues. These results underscore the need for optimizing tax revenue strategies, particularly from petroleum sources, and for prudent management of non-tax revenues to maximize their economic impact and sustain long-term growth in Algeria.

Keywords

Tax revenues;
Economic growth; Quantile ARDL;
Non-tax revenue;
Algeria.

تأثير الإيرادات الضريبية على النمو الاقتصادي في الجزائر: نهج ARDL الكمي

ملخص

في تأثير الإيرادات الضريبية على النمو الاقتصادي في الجزائر من عام 1970 إلى عام 2023 باستخدام نهج ARDL الكمي. وتدرس الدراسة على وجه التحديد آثار إيرادات ضريبة البترول (PTR) وإيرادات الضرائب العادية (RTR) والإيرادات غير الضريبية (NTR) على نمو الناتج المحلي الإجمالي. وتسلط النتائج الضوء على أن PTR يعزز باستمرار وبشكل كبير نمو الناتج المحلي الإجمالي في جميع القطاعات، مما يؤكد الدور الحاسم لقطاع الهيدروكربونات في الجزائر في دفع عجلة التوسع الاقتصادي. وعلى العكس من ذلك، يظهر RTR تأثيرًا إيجابيًا على نمو الناتج المحلي الإجمالي في معظم القطاعات. ومع ذلك، يُظهر NTR تأثيرًا سلبيًا على نمو الناتج المحلي الإجمالي في جميع القطاعات، مما يشير إلى أوجه قصور محتملة في تحفيز النشاط الاقتصادي مقارنة بإيرادات الضرائب. وتؤكد هذه النتائج على الحاجة إلى تحسين استراتيجيات الإيرادات الضريبية، وخاصة من مصادر البترول، والإدارة الحكيمة للإيرادات غير الضريبية لتعظيم تأثيرها الاقتصادي والحفاظ على النمو طويل الأجل في الجزائر.

الكلمات المفتاحية

إيرادات ضريبية؛
نمو اقتصادي؛
الكمي ؛ ARDL
إيرادات غيرضريبية؛
الجزائر .

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I- Introduction:

About 260 years ago, the great philosopher and economist Adam Smith observed that to achieve the highest degree of wealth, a state needs only three essential elements: peace, moderate taxes, and acceptable judicial administration. This reasoning underlines the importance of taxes in building a prosperous society, as they are perceived as more sustainable and predictable. Therefore, tax is of particular importance in the life of society and the state; in 1917, the economist Schumpeter proposed the idea that taxes constitute the method of financing used by the State (Schumpeter, 1991), thus representing one of the most important sources of public revenue. Tax, in its modern conception, is no longer a neutral tool but has become an instrument of intervention used by the State to serve political, economic and social objectives (reflecting the interventionist policy of the State), in the goal of achieving the World Bank Group's goals of eradicating extreme poverty and fostering shared prosperity by 2030.

In this context, Policymakers and economists must study the link between tax revenue and economic growth, especially in emerging nations where the balance between public income and economic growth is sensitive. Algeria's dependence on oil earnings and drive for economic diversification makes understanding this dynamic vital. This research, "The Effect of Tax Revenues on Economic Growth in Algeria: A Quantile ARDL Approach", uses sophisticated econometric tools to examine how tax revenues affect Algeria's economy.

Algeria's GDP and exports have relied primarily on oil and gas profits. Global oil price variations have revealed the weaknesses of such an economic framework, necessitating a more stable and diversified income basis. Thus, taxation is essential for economic growth and stability. Tax income has had different effects on economic growth depending on the tax system and each country's financial situation (; Adefolake & Omodero, 2022).

Tax revenue and economic growth in Algeria are complicated. Tax policy must stimulate investment and economic activity while raising income for governmental spending. A Quantile Autoregressive Distributed Lag (QARDL) technique, building on previous research, provides for a more detailed examination of tax revenues across economic growth quantiles. This strategy is ideal for capturing the variation in tax revenue and economic growth, which mean-based regression models cannot (Arvin et al., 2021; Nguyen et al., 2023).

This study analyzes how income, corporation, and value-added taxes impact Algerian economic growth. It seeks to determine which taxes promote economic growth and under what conditions. The report also recommends tax policy changes to promote sustainable economic growth. Algeria experienced major economic and policy developments from 1999 to 2019. The QARDL technique analyzes long-term linkages and short-term dynamics to show how tax revenues affect economic growth at different phases. New econometric methods highlight distributional effects in economic research, supporting this methodological approach (Gllogjani & Durguti, 2023).

This paper provides empirical data from Algeria, a resource-dependent emerging economy, to the fiscal policy and economic growth debate. The findings could help policymakers choose tax schemes that boost economic development and budgetary sustainability. This research fills a vacuum in the literature and offers practical advice for other developing nations experiencing comparable issues by focusing on Algeria.

I.1. Literature review:

A growing body of economic literature has examined the complicated link between tax revenue and economic development. Research suggests that a well-structured tax system may boost economic growth by funding infrastructure, education, and healthcare, which boosts productivity and attracts investment. Tax income affects economic growth, but various factors affect its strength and direction.

Recent research has shown the complex tax revenue-economic growth relationship. (Emudainohwo & Ndu, 2022) used the ICTD UNU-WIDER Government Revenue Dataset to find that revenue-neutral income tax increases may impair long-term GDP growth. In contrast, trade tax reductions have only sometimes helped. This shows that the best tax system for economic growth may differ per country, especially in emerging nations.

Different tax income sources and their effects on economic growth have also been studied. (McNabb, 2018) examined how oil and non-oil tax collections affect Nigerian economic growth. Petroleum profit tax and customs and excise duties tax positively and significantly correlated with economic growth, but corporate income tax and value-added tax negatively correlated. This emphasizes the necessity of carefully assessing tax income sources to boost economic growth.

Institutional quality has also been studied in relation to tax revenue and economic growth. (Otekunrin et al., 2023) used an AI-based strategy to find that institutional quality and AI can help economic growth, but AI and tax revenue do not. AI may boost economic development, but institutional frameworks and AI-friendly tax laws may affect its impact.

(Saba & Monkam, 2024) examined how population aging affects economic growth and publics revenus and found that revenue-neutral tax mix modifications may offset economic growth problems. Their analysis revealed that switching from personal income taxes to consumption taxes may boost revenue, especially in aging nations.

Many researches have used econometric models to examine tax revenue and economic growth. In G7 nations, (Achou et al., 2022) discovered bidirectional causation between economic growth and government expenditure but unidirectional causality between tax income and government expenditure using panel causality. This underscores their interconnectivity and the necessity for policy measures that include tax income and government expenditure.

The long-run cointegrating link between tax revenue and economic growth was tested using the ARDL-bounds method. Using Turkish data, (Gurdal et al., 2021) discovered a positive link between tax revenue and GDP, with a 1% rise in GDP leading to a 2.92% increase in tax revenues.

To fully comprehend the relationship between tax revenues and economic growth in Algeria, it is essential to take into account the country's economic and political context. An in-depth analysis of this impact necessitates a thorough understanding of the Algerian tax system, the composition of tax revenues, and the efficiency of tax collection. By employing the ARDL technique, it becomes possible to examine both the long-term and short-term patterns of tax revenue and economic growth, while also considering factors such as fluctuations in oil prices, government expenditure, and investment levels.

It is important to recognize the limitations of quantitative approaches. Qualitative research offers valuable insights into the implementation of tax policies, taxpayer behavior, and the broader social and political impacts of taxation. In the context of Algeria, a qualitative study can provide a deeper understanding of the connection between tax revenue and economic growth.

I.1.1 Research gap:

Tax revenue and economic development in Algeria have been studied, but their dynamic, diverse, and time-dependent relationship is unclear. This innovative study uses the dynamic quantile model ARDL to study how tax revenue affects economic growth at quantiles of the growth distribution and in the short, long, and episodic periods. This innovative tool helps policymakers assess how tax revenue affects economic growth in Algeria. This is the first application of the dynamic quantile model ARDL to Algeria, which is necessary to determine whether and how tax revenue affects economic growth in the short, long, and episodic periods. It is important to recognize that quantitative methods have their limitations. Qualitative research can shed light on the implementation of tax policies, taxpayer behavior, and the social and political impacts of taxation. Qualitative research helps explain the relationship between tax revenue and economic growth in Algeria.

I.1.2 Research Problem

The research problem is the need to understand how tax revenue affects economic growth in the short and long term, taking into account differences across different time periods. This problem arises because traditional economic methods cannot capture the dynamic variation of the relationship between tax revenue and growth at different levels of the GDP distribution. Therefore, the study aims to address this gap by using the Quantitative ARDL (QARDL) model, which allows for the analysis of the nonlinear relationship between variables across different quantiles.

I.1.3 Research Focus

This study focuses on analyzing the dynamic relationship between tax revenue and economic growth in Algeria, using the Quantitative ARDL model. This model allows for the examination of short- and long-term effects across different periods of economic growth, helping to reveal how the relationship between tax revenue and growth changes under different economic scenarios.

I.1.4 Research Objective and Questions

The study aims to analyze the relationship between tax revenue and economic growth in Algeria, focusing on the variation of this effect across different quantiles of the GDP distribution, using the QARDL model. The study seeks to answer the following research questions:

1. What is the nature of the relationship between tax revenues and economic growth in Algeria, and does it change across different growth periods?
2. How do oil, regular, and non-tax tax revenues affect economic growth in the short and long term?
3. What is the extent of variation in the impact of tax revenues on growth at different levels of the GDP distribution, according to the QARDL model?

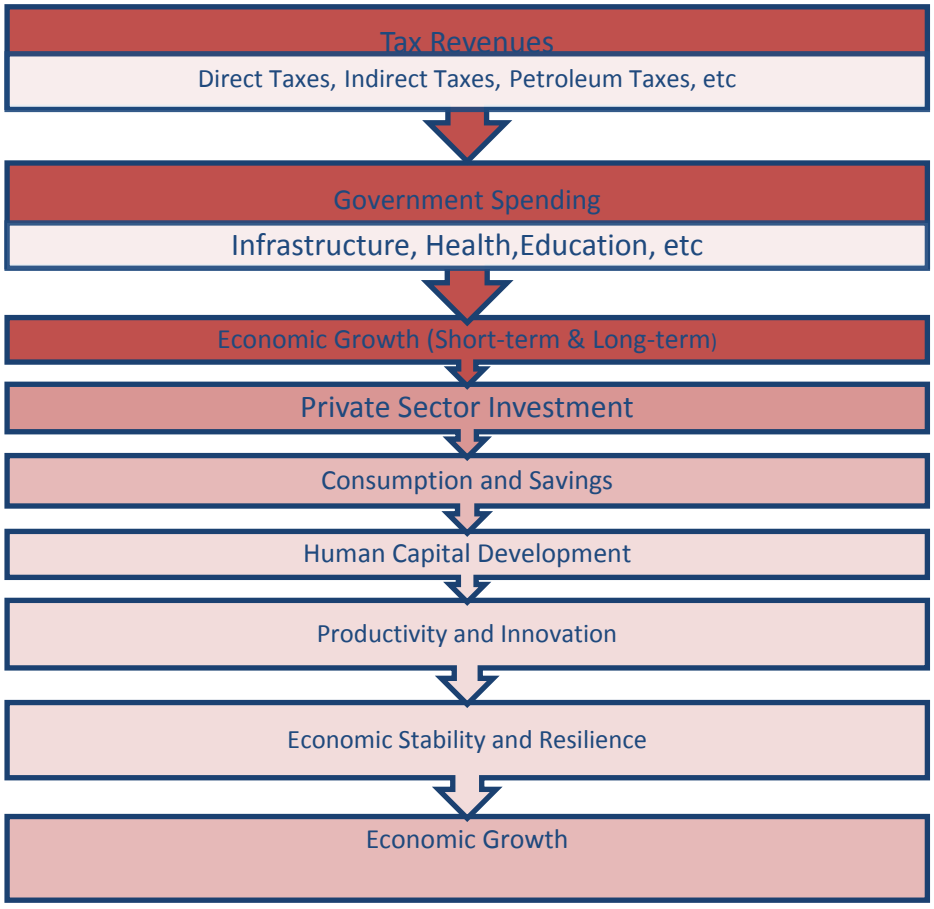
I.2. Theoretical Underpinning:

For decades, economists have debated tax revenue and economic development (Erdoğdu & Siverekli, 2019). Classically, increasing tax income boosts government expenditure on public goods and infrastructure, which boosts economic activity (McNabb, 2018), but newer research shows a more complicated relationship (Chang et al., 2006). The tax system, government spending efficiency, and macroeconomic situation all contribute to this complexity (Hakim, 2020).

There are various theoretical frameworks that offer explanations for this correlation. According to (Arvin et al., 2021), a robust financial market, such as the stock market, has the potential to enhance economic growth. However, the impact of taxes on financial activity can either hinder or facilitate this process. This paradigm emphasizes the importance of a supportive fiscal environment and a thriving financial sector in promoting economic growth. (Taha et al., 2010) suggests that a well-designed tax structure can incentivize investment and innovation, thereby stimulating economic growth and increasing tax revenue. It is worth noting that the influence of tax revenue on economic growth can vary significantly across countries and circumstances. Factors such as economic progress, institutional quality, and tax structure may all contribute to this relationship (Adefolake & Omodero, 2022). Furthermore, studies indicate that the effects of tax revenue on economic development can be mitigated by trade openness and internal control systems (Ho et al., 2023).

Tax revenues play a key role in shaping economic growth through multiple, interrelated channels. First, tax revenues enable governments to spend on infrastructure, health, education, and other public services, which are essential for improving human capital and productivity. Government spending stimulates short-term economic activity while promoting long-term growth by developing a more skilled and healthier workforce. In addition, improvements in public infrastructure and services can attract private investment, further boosting economic growth. Tax policies also influence household consumption and saving behavior and affect overall demand in the economy. In addition, sustainable and adequate tax revenues contribute to economic stability by ensuring the continued provision of public services and reducing credit dependence. Consequently, the combined effects of enhanced infrastructure, increased private investment, improved human capital, and economic stability lead to sustained and robust economic growth.

Figure 01: The Role of Tax Revenues in Achieving Economic Growth

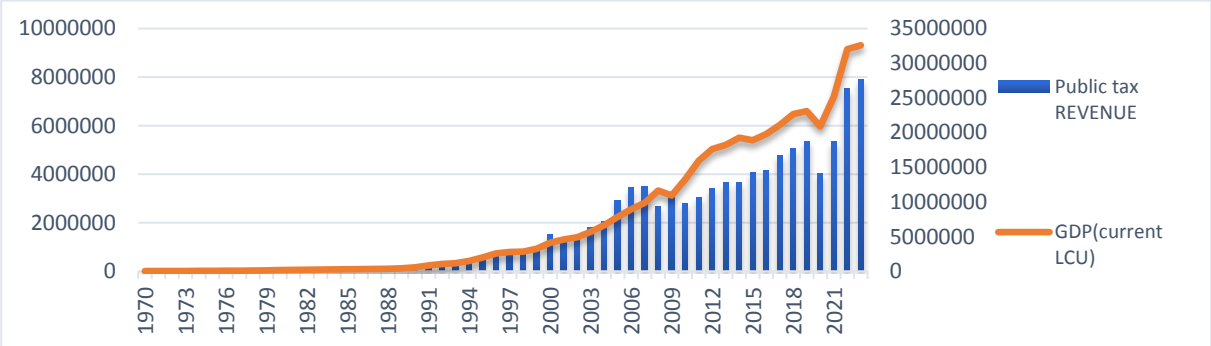


Source: Prepared by researchers Based on literature review.

I.2.1 Analysis Tax revenue and Gross Domestic Product in Algeria

Tax revenues constitute an important source of government revenues that can be relied upon to build and expand the economic growth. What distinguishes the structure of public revenues in Algeria is its heavy reliance on fiscal resources, especially petroleum taxes, which has greatly affected the structure of public revenues**.**

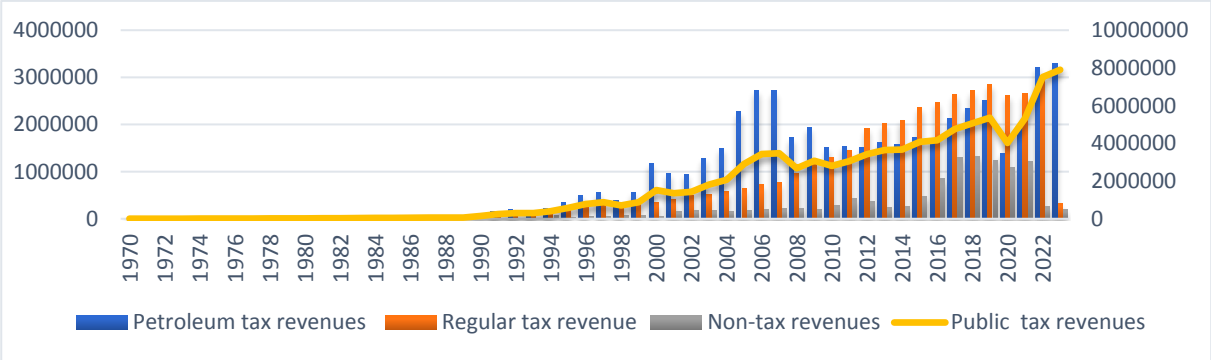
Figure 02: **Evolution of public tax revenues with GDP in Algeria (1970-2023)**



Source: the data available at the following links:
https://www.ons.dz/IMG/pdf/CH12_Finnance_Public1962_2020Ar.pdf and
https://data.worldbank.org/indicator/NY.GDP.MKTP.CN?skipRedirection=true&view=map

From 1970 to 2023, Algeria's total revenue and GDP have shown significant growth, reflecting the country's evolving economic landscape. Total revenue increased from 4,106 million in 1970 to 7,901,900 million in 2023, while GDP grew from 24,011.52 million to 32,588,650.5 million over the same period. This growth is marked by notable surges in the 1980s and 2000s, likely due to oil price booms and economic reforms. The revenue-to-GDP ratio indicates improvements in fiscal capacity and revenue collection efficiency. Despite fluctuations linked to global economic conditions, the strong correlation between total revenue and GDP underscores the intertwined nature of government finances and economic performance in Algeria.

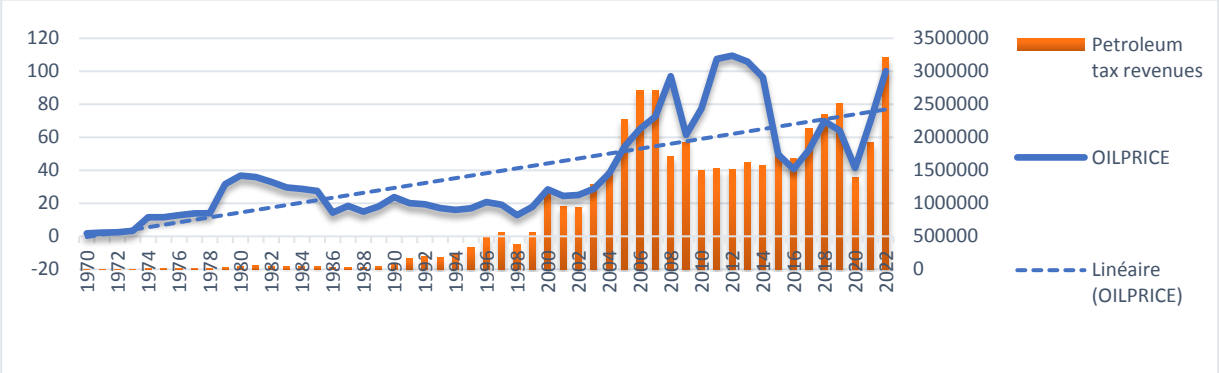
Figure 03: Evolution of tax and non-tax revenues from total public tax revenues (1970-2023)



Source: the data available at the following links:
https://www.ons.dz/IMG/pdf/CH12_Finnance_Public1962_2020Ar.pdf

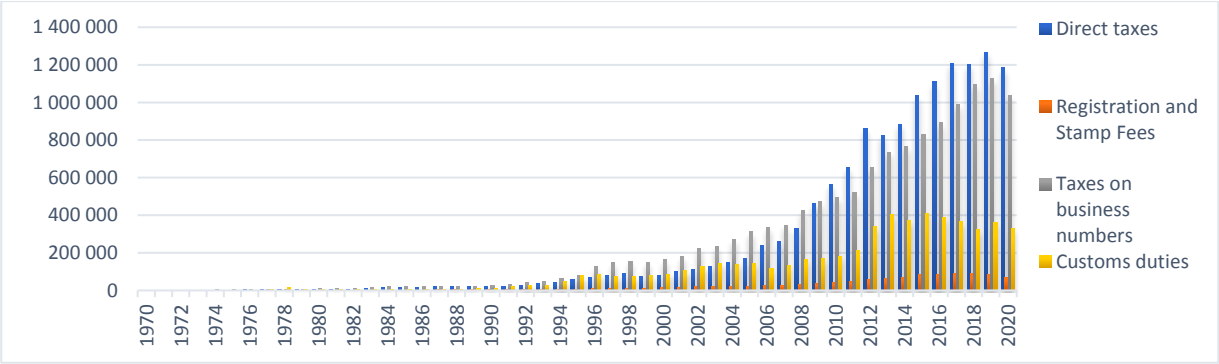
From 1970 to 2023, Algeria's fiscal landscape has been predominantly shaped by its petroleum tax revenues, which have experienced significant fluctuations, peaking notably in the early 2000s and again in 2023. This heavy reliance on oil is reflected in the substantial spikes in total revenue during periods of high global oil prices (Figure 04). Concurrently, regular tax revenues have shown a steady upward trend, particularly from the 1990s onwards, indicating improvements in tax collection and efforts towards broadening the fiscal base (Figure 05). Non-tax revenues, though more variable, have contributed significantly in certain years, highlighting occasional large-scale income from government enterprises or other sources. The overall trend in revenue growth, coupled with the corresponding increases in GDP, underscores the intertwined nature of Algeria's economic performance and its fiscal health, with a clear imperative for continued diversification away from volatile petroleum dependence to ensure long-term fiscal stability and sustainable economic growth.

Figure 04: **Evolution of petroleum tax revenues with oil prices in Algeria (1970-2023)**



Source: the data available at the following links: www.ons.dz ،www.dgpp-mf.gov.dz
Oil prices can be viewed by accessing the following link: https://www.opec.org/opec_web/en/data_graphs/40.htm

Figure 05: **Evolution of Regular tax revenue in Algeria (1970-2020)**



Source: the data available at the following links: www.ons.dz ،www.dgpp-mf.gov.dz

while Algeria has made strides in improving tax collection and diversifying its revenue base, the economy remains vulnerable to oil price fluctuations. Continued efforts towards economic diversification and strengthening non-oil revenue streams are crucial for future fiscal health and economic resilience.

Table01: Tax revenue to GDP ratio in Algeria (2000-2022)

Year	Petroleum tax revenues (1)	Regular tax revenues (2)	(1) % GDP	(2) % GDP	**Year**	Petroleum tax revenues	Regular tax revenues (2)	(1) % GDP	(2) % GDP
2000	1173237	349502	28,45	8,47	**2008**	1715400	965289	14,72	8,28
2001	956389	398238	20,84	8,68	**2009**	1927000	1146612	17,64	10,49
2002	942904	482895	19,23	9,85	**2010**	1501700	1297944	11,35	9,81
2003	1284975	524925	22,59	9,23	**2011**	1529400	1448898	9,60	9,09
2004	1485699	580411	22,43	8,76	**2012**	1519040	1908576	8,62	10,83
2005	2267836	640472	28,91	8,16	**2013**	1615900	2031019	8,86	11,14
2006	2714000	720884	30,35	8,06	**2014**	1577730	2091456	8,19	10,86
2000	2711850	766750	27,46	7,76	**2015**	1722940	2354648	9,12	12,47
2001	1715400	349502	28,45	8,47	**2016**	1682550	2472208	8,50	12,49
2002	1927000	398238	20,84	8,68	**2017**	2126987	2630003	10,09	12,48
2003	1501700	482895	19,23	9,85	**2018**	2349694	2711762	10,35	11,95
2004	1529400	524925	22,59	9,23	**2019**	2518488	2843465	10,90	12,31
2005	1519040	580411	22,43	8,76	**2020**	1394710	2625168	6,67	12,55
2006	1615900	640472	28,91	8,16	**2021**	1919200	2651700	7,62	10,54
2007	1577730	720884	30,35	8,06	**2022**	3211900	2984800	10,028	9,319

Source: The calculation was prepared by researchers based on the data available on the links: www.ons.dz ،www.dgpp-mf.gov.dz

Based on the table illustrated above, we observe that the contribution rates of regular tax revenues as a percentage of the Gross Domestic Product (GDP) have shown continuous improvement and increase throughout the study period, reaching a peak of 12.5% in 2020. This development in regular tax revenue collection is attributed to the increasing number of taxpayers due to public investment programs, such as the supplementary growth support program, which was allocated financial credits amounting to 286 billion$. All these programs have contributed to the enhancement of regular tax revenues and the improvement of tax administration efficiency. Meanwhile, petroleum revenues represented a high percentage of GDP, reaching 28.45% in 2005. However, this percentage began to decline due to fluctuations in global oil prices. Although petroleum tax revenues appear to dominate the larger share, they are subject to global oil market volatility, as clearly illustrated in Figure 04.

II– Methods and Materials:

II-1 Methods

This study seeks to analyze whether and how tax revenue concentration affects economic growth in the short, long, and intermittent terms, with the aim of identifying the stages at which these effects become evident. To achieve this, the dynamic quantitative ARDL model is used, which, as noted in the introduction, provides a comprehensive understanding of the relationship between tax revenue and growth. This model is based on an extension of the ARDL model presented by Kwanbo et al. (2022), by analyzing the variance of this relationship across different parts of the distribution of the conditional dependent variable ($0 < \tau < 1$). This feature allows for the variance of tax revenue and growth to be accommodated, helping to reveal how this relationship changes according to different economic conditions.

II-1-1 Theoretical Model

This research aims to study the dynamic relationship between tax revenue and economic growth over different time periods, focusing on how this relationship changes at different levels of the economic growth distribution. To achieve this, we rely on the dynamic quantile autoregressive distributed lag (ARDL) model, which allows for analysis of the relationship across different quantiles, providing a deeper insight into the variance of the impact of tax revenue on growth.

The analysis begins with the following basic model, which demonstrates the dependence of the dependent variable yt on a set of explanatory variables x1t and x2t:

$$\boldsymbol{y_t = f(x_{1t}, x_{2t})} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(01)$$

Based on this foundation, the model is developed according to the dynamic quantitative ARDL methodology, where the relationship between the explanatory variables and the dependent variable is expressed at specific quantities (τ), taking into account the lagged values of the variables:

$$y_t = \beta_0(\tau) + \beta_1(\tau)y_{t-1} + \beta_2(\tau)x_{1t} + \beta_3(\tau)x_{2t} + \lambda_1(\tau)x_{1t-1} + \lambda_2(\tau)x_{2t-1} + \mathcal{E}_t \ldots\ldots\ldots\ldots (02)$$

Where:

- $\boldsymbol{\beta_i}$: The coefficients represent the current values of the variables at the specified quantile(τ).
- $\boldsymbol{\lambda_i}$: The coefficients represent the values of the variables at a specific quantile, taking into account their lagged values.
- $\mathcal{E}_t$: The error term at time t.

In the context of the study, the model is dedicated to studying the relationship between the gross domestic product (GDP) and its tax components, using the following formula:

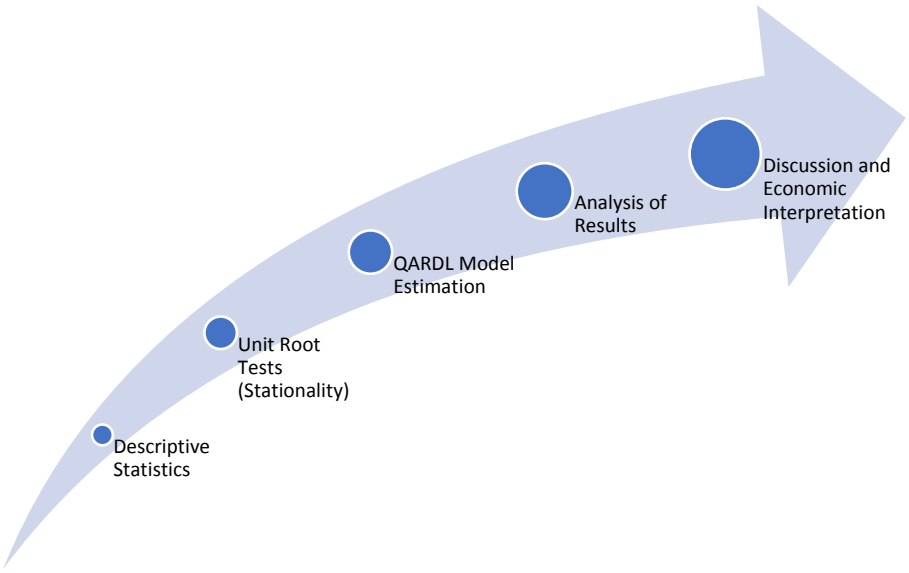
$$GDP_t = \beta_0(\tau) + \beta_1(\tau)RGDP_{t-1} + \beta_2(\tau)PTR_t + \beta_3(\tau)RTR_t + \beta_4(\tau)NTR_t + \lambda_1(\tau)PTR_{t-1} + \lambda_2(\tau)RTR_{t-1} + \lambda_3(\tau)NTR_{t-1} + \mathcal{E}_t \ldots\ldots\ldots\ldots(03)$$

To understand the dynamic relationship between tax revenue and economic growth in Algeria, we relied on the quantile autoregressive distributed dynamic lag (QARDL) model, which allows for the analysis of variations in the relationship between variables at different levels of the conditional distribution of the dependent variable. This model

allows us to test the impact of tax revenues, with its various components, on economic growth not only on average, as traditional models do, but also across different quantitative strata, providing a more comprehensive picture of the relationship between variables.

The estimation process goes through several basic stages, starting with descriptive statistical analysis, followed by unit root tests to ensure time series stationarity, and finally estimating the QARDL model and analyzing its results. The following figure illustrates the main stages of this methodological process.

Figure 06: Stages of QARDL model estimation



Source: Author's development.

II-2 Data Analysis

This study relies on annual data covering the period from 1970 to 2023 and focuses on the Algerian economy by analyzing the relationship between tax revenues and economic growth. The variables used in the analysis include petroleum tax revenues (PTR), regular tax revenues (RTR), non-tax revenues (NTR), and gross domestic product (GDP).

To achieve the study's objectives, a dynamic quantile autoregressive distributed lag (QARDL) model was adopted, which allows for the analysis of changes in the relationship between tax revenues and economic growth across different quantiles. This model is characterized by its ability to accommodate structural variation and heterogeneity in the impact of tax revenues on growth, providing a more comprehensive understanding of this relationship in both the short and long term.

This section aims to provide a detailed overview of the data sources and methods for measuring the variables, with a focus on the statistical methodology used to analyze the dynamic relationship between tax revenues and economic growth in Algeria.

Table02 : Data Source

Variables	Descriptions	Measurement	Sources
independent variables			

PTR	Petroleum tax revenues	In millions, DZA	the data available at thewww.ons.dz ،www.dgpp-mf.gov.dz following links : https://www.ons.dz/IMG/pdf/CH12_Finnance_Public1962_2020Ar.pdf and https://dgpp.mf.gov.dz/wp-content/uploads/2023/01/RFLF_2021_francais-1.pdf
RTR	Regular tax revenue.	In millions, DZA	the data available at thewww.ons.dz ،www.dgpp-mf.gov.dz following links : https://www.ons.dz/IMG/pdf/CH12_Finnance_Public1962_2020Ar.pdf and https://dgpp.mf.gov.dz/wp-content/uploads/2023/01/RFLF_2021_francais-1.pdf
NTR	Non-tax revenue.	In millions, DZA	the data available at thewww.ons.dz ،www.dgpp-mf.gov.dz following links: https://www.ons.dz/IMG/pdf/CH12_Finnance_Public1962_2020Ar.pdf and https://dgpp.mf.gov.dz/wp-content/uploads/2023/01/RFLF_2021_francais-1.pdf

dependent variable

GDP	Gross Domestic Product	current LCU(In millions)	the data available at the worldbank following links : https://data.worldbank.org/indicator/NY.GDP.MKTP.CN?locations=DZ

Source: Author's development.

III- Résultats and Discussion :

III-1- Résultats

III-1-1 Descriptive statistics

The estimation process begins with the first stage, descriptive statistics analysis, in which the statistical properties of the studied variables are examined, such as the mean, median, standard deviation, and probability distribution. This analysis allows us to understand the nature of the data, determine the extent of its dispersion, and detect any outliers that may influence the results. It also helps us gain an initial insight into the behavior of variables over time before moving on to more advanced tests, such as unit root tests, which aim to determine the level of integration of time series and ensure their stationarity.

Table 03: Descriptive statistics

	GDP	RTR	PTR	NTR
Mean	5623373.	724221.3	903700.4	217031.8
Median	1741050.	302308.0	437276.5	51656.00
Maximum	22021500	2984800.	3298500.	1328013.
Minimum	3.200000	744.0000	1350.000	744.0000
Std. Dev.	7123683.	970960.7	988368.6	363445.5
Skewness	1.028641	1.196039	0.764933	2.123896
Kurtosis	2.530113	2.886260	2.373528	6.308224
Jarque-Bera	10.01970	12.90369	6.149148	65.22317
Probability	0.006672	0.001578	0.046209	0.000000
Sum	3.04E+08	39107948	48799824	11719719
Sum Sq. Dev.	2.69E+15	5.00E+13	5.18E+13	7.00E+12
Observations	54	54	54	54

Source: Author's development.

Table 03 provides descriptive statistics for GDP, RTR, PTR, and NTR. The average GDP is 5,623,373, while RTR, PTR, and NTR average 724,221.3, 903,700.4, and 217,031.8, respectively, indicating that GDP is significantly higher than the other income streams. The median values for each variable are lower than their respective means,

suggesting a skewed distribution likely influenced by a few high values. Both GDP (7,123,683) and RTR (970,960.7) exhibit high standard deviation values, indicating greater variability around the mean compared to PTR and NTR. The positive skewness observed in all variables, particularly GDP and RTR, suggests the presence of outliers that elevate the mean. The low p-values for all variables, especially GDP (0.006672) and RTR (0.001578), imply significant deviations from a normal distribution, corroborating the earlier observation of skewed distributions with outliers. All variables consist of 54 observations, reflecting a consistent dataset. These descriptive statistics reveal that GDP has the highest mean and standard deviation among the revenue sources, all variables exhibit skewness due to outliers, and none adhere to a normal distribution.

III.1.2 Unit root tests:

The Augmented Dickey-Fuller (ADF)(Pesaran et al., 2001) and KPSS (Kwiatkowski-Phillips-Schmidt-Shin)(Dickey & Fuller, 1979) unit root tests on four variables—RGDP, RTR, PTR, and NTR—are shown in the table. Tests were done under "Intercept" and "Intercept and Trend." The ADF test rejects the unit root null hypothesis, indicating a non-stationary time series. A low p-value (usually less than 0.05) indicates stationarity and null hypothesis rejection. The results appear in the Table No. 04.

Table 04: unit root test

Unit root tests,		**ADF Test**		**KPSS Test**	
Variables		Intercept	Interept and Trend	Intercept	Interept and Trend
RGDP	t-Statistic	-6.4679	-5.2309	0.7577	0.1500
	Prob.	0.0000	0.0006	***	**
		***	***		
RTR	t-Statistic	-7.3844	-7.1812	0.6872	0.1993
	Prob.	0.0000	0.0000	**	**
		***	***		
PTR	t-Statistic	-0.2231	-2.8475	0.9126	0.1466
	Prob.	0.0186	0.0177	***	**
		**	**		
NTR	t-Statistic	1.7406	1.3654	0.6392	0.1557
	Prob.	0.0996	1.0000	**	**
		*	n0		

Source: Author's development.

III.1.3 QARDL models estimates:

To understand the dynamics of the relationship between the studied economic variables, the QARDL model was used. This model allows for the analysis of short- and long-term effects while taking into account variations across different levels of the distribution of the dependent variable. This model is characterized by its ability to detect nonlinear relationships and heterogeneity of effects between variables across different quantiles, providing a more accurate view compared to traditional models. In this context, Table 5 presents the model coefficient estimates at several quantiles (τ = 0.10, 0.25, 0.50, 0.75, 0.90), allowing us to determine how the relationship between the explanatory variables and the dependent variable changes at different levels of the distribution. In the next section, these estimates are analyzed and their economic implications are discussed.

Table 05: Results Parameter estimates of the QARDL models.

Quantiles	τ **0.10**	τ **0.25**	τ **0.50**	τ **0.75**	τ **0.9**
$\boldsymbol{\beta_0(\tau)}$	-1.411 (-0.820)	-1.054 (-0.310)	2.369 (0.080)	2.918 (0.24)	1.376 (2.53)
$\boldsymbol{\beta_1(\tau)}$	1.879 (7.060) ***	1.725 (3.310) **	-0.871 (1.790) *	0.836 (4.51) ***	0.763 (9.060) ***
$\boldsymbol{\beta_2(\tau)}$	-1.648 (-4.070) ***	-1.742 (-2.19) **	1.176 (1.580)	0.755 (2.670) **	0.801 (6.250) ***

$\boldsymbol{\beta_3(\tau)}$	-9.953 (-4.230) ***	-8.615 (-1.870) *	1.664 (0.390)	2.472 (1.510)	2.808 (3.770) ***
$\boldsymbol{\beta_4(\tau)}$	16.720 (17.140) ***	16.548 (8.660) ***	1.692 (0.950)	8.263 (12.160) ***	7.598 (24.60) ***
$\boldsymbol{\lambda_1(\tau)}$	1.172 (2.030) **	1.743 (1.540)	-0.688 (-0.650)	-0.087 (-0.220)	0.130 (0.710)
$\boldsymbol{\lambda_2(\tau)}$	1.865 (2.740) ***	1.174 (0.880)	-0.618 (0.500)	-0.716 (-1.510)	-1.331 (-6.180) ***
$\boldsymbol{\lambda_3(\tau)}$	-14.626 (-15.28) ***	-14.265 (-7.610) ***	-2.857 (-1.630)	-9.922 (-14.880)	-6.413 (-21.160) ***

Note: Table shows quantile estimation findings. The t-statistics are bracketed. *, **, and *** show significance at 1%, 5%, and 10%.

Source: Author's development.

This table presents ARDL model quantile regression estimates, examining the impact of Petroleum Tax Revenues (PTR), Regular Tax Revenue (RTR), and Non-Tax Revenue (NTR) on GDP. The results indicate that higher PTR consistently enhances GDP growth, as evidenced by the positive and significant PTR coefficients across all quantiles. This effect is particularly pronounced at higher quantiles, suggesting a more substantial influence of PTR on GDP growth in these scenarios.

RTR also positively influences GDP growth, with most quantiles showing positive and significant RTR coefficients, except for the 0.1 quantile. This suggests that while RTR generally boosts GDP growth, its effect may be less pronounced in lower-GDP contexts. Conversely, NTR exhibits negative and significant coefficients across all quantiles, indicating that higher non-tax receipts adversely impact GDP growth.

The negative impact of NTR on GDP growth could be due to less efficient stimulation of economic activity compared to tax revenues or potential crowding-out effects. These findings underscore the crucial role of tax revenues, particularly petroleum tax revenues, in driving GDP growth. They highlight the importance of government revenue mobilization, especially through resource-based taxes, to foster economic growth.

However, the results also emphasize the need for a nuanced analysis of different revenue sources and their specific impacts on economic growth. While conventional tax revenues support growth, the negative impact of non-tax revenue suggests a need for policy evaluation to optimize their developmental contribution. Future research could explore the lagged effects of revenue variables on GDP to understand how historical revenue levels influence GDP growth. Additionally, Chow tests could identify structural breaks in the relationship due to policy changes or economic shocks.

These insights can inform policymakers on the differential effects of various revenue sources on economic growth, guiding strategies for tax, resource, and non-tax revenue optimization. It is essential to consider the analysis context—country, period, and data sources—as well as other macroeconomic factors like investment, consumption, and external influences for a comprehensive economic assessment.

III-2 Discussion

The results of the QARDL model estimations reflect the significant variation in the impact of the explanatory variables across the different levels of the dependent variable, indicating heterogeneity in the economic relationships between the studied variables. The analysis reveals that some variables play a decisive role at the low and high values of the dependent variable, while their impact is weak or insignificant at the intermediate values. This reinforces the importance of using quantile-based quantitative analysis to more accurately understand economic interactions.

One of the most notable results is the strong impact of some variables at the two extremes of the distribution, as is the case with β_1 (ŧ), which shows a positive and significant impact at τ=0.10 and τ=0.90, indicating that this variable plays an important role in determining the dependent variable in extreme scenarios. In contrast, the impact of β_3 (ŧ) is negative at the low values and positive at the high values, indicating that the relationship between this variable and the dependent variable depends largely on the level of the dependent variable itself, reflecting the non-linearity of the economic relationship between them.

Regarding long-term effects, some variables, such as λ_3 (ŧ), appear to have a strong and significant negative effect at both low and high values, suggesting that this variable may be a constraint on long-term financial growth or

stability. On the other hand, the long-term effect of λ_1 (ȶ) is significant only at the lower quantiles, suggesting that its impact may be limited under certain economic conditions.

These results support the need to reconsider traditional economic models that assume homogeneity of effects, as quantile analysis demonstrates that economic relationships are not uniform across the distribution but rather vary depending on the level of the dependent variable. Therefore, economic policies designed based solely on the average of the relationships may not be effective in addressing the most affected groups. For example, if the goal of economic policy is to improve financial performance under difficult conditions, focusing on the results of the lower quantiles may be more effective than traditional average analysis.

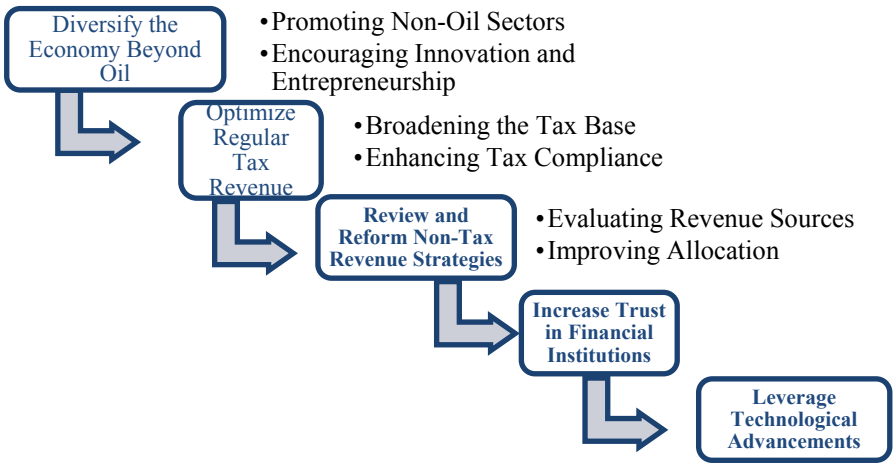
Based on these findings, it is recommended to conduct a more detailed analysis of the dynamic relationships between economic variables, particularly by incorporating nonlinear analysis methods, such as extended QARDL models, which can capture asymmetric effects between variables over time. The use of other measures, such as structural stability tests, may also help determine the stability of these effects across different time periods, contributing to a deeper and more accurate understanding of the mechanisms of economic impact.

IV- Conclusion:

This study uses a quantile ARDL approach to examine the impact of petroleum tax revenues (PTR), regular tax revenues (RTR), and non-tax revenues (NTR) on GDP growth in Algeria from 1970 to 2023. The results show that the PTR consistently has a positive and significant impact on GDP growth across all quantiles, which is particularly evident at higher levels, highlighting the central role of the Algerian hydrocarbon sector in economic expansion. Conversely, the RTR shows a positive impact on GDP growth across most quantiles, indicating its supportive role for economic performance, although less pronounced at lower GDP levels. In contrast, the NTR shows a negative impact on GDP growth across all quantiles, suggesting that it may be less efficient in stimulating economic activity relative to tax revenues. These results imply the importance of optimizing tax revenue strategies, particularly from petroleum sources, while carefully managing non-tax revenues to maximize their economic contribution and sustain long-term growth in Algeria.

The quantile regression estimation results of the ARDL model examine the impact of (PTR), (RTR), and (NTR) on GDP, based on which some recommendations can be made for the Algerian economy. First, improving PTR collection is crucial as it has a positive and significant impact on GDP growth; these include improved efficiency, stronger regulation, and technological investment. Second, diversifying the economy beyond oil by promoting non-oil sector development and encouraging innovation and entrepreneurship is essential to reduce vulnerability to oil price fluctuations. Third, optimizing the RTR can further support economic growth by broadening the tax base and improving compliance. Fourth, given the negative impact on GDP growth, non-tariff barrier policies need to be reviewed and reformed to eliminate inefficiencies and allocate revenue efficiently. Fifth, enhancing trust in financial institutions and improving institutional quality through anti-corruption measures can promote a good business environment. Finally, leveraging technological advances by promoting digital infrastructure and fintech innovation can improve financial inclusion and economic efficiency. Implementing these recommendations can help Algeria reap tax gains while addressing challenges posed by non-tax revenue, thereby promoting sustainable economic growth and development.

Figure 05: Summary of the most important strategies.



Source: **Prepared by researchers.**

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