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QUANTILE REGRESSION ANALYSIS OF CLIMATE-INDUCED INFLATION AND ITS IMPLICATIONS FOR ALGERIA'S ECONOMIC STABILITY AND NATIONAL SECURITY

This study examines the correlation between inflation and meteorological factors in Algeria using quantile regression analysis. The main goal is to find out how changes in climate affect inflation. The results reveal that average temperature has a significant impact on inflation while it is low. This suggests that climate-driven pressures are stronger when circumstances are stable. These findings show that policymakers need to put temperature-related risks at the top of decision priorities.

Keywords: *Inflation; National Security; Climate changes; Quantile Regression; Algeria.*

The stability of the economy, with its many components and large complexes, is one aspect of national security. Economic stability is an essential component of the country's security, sovereignty, and stability. It manifests itself via a country's authority and ability to preserve its economic interests while being financially indepen-

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dent. Furthermore, it ensures resilience against both internal and external attacks. This approach combines economic policy and national security strategies to address weaknesses in a country's commerce, resources, and strategic industries (Baldwin, 1997). Economic security issues have typically been centered on health uncertainties, retirement demands, and income interruption protection (Losman, 2001). The national security policy encompasses decisions and actions that are critical to preserving domestic basic values from external threats. The national security approach also serves as a thorough interpretive framework for studying foreign affairs. A widespread belief exists that realism scholars contend diplomatic conduct should be primarily determined by the distribution of power within the international system, suggesting that domestic economic factors and social institutions have significant relevance (Leffler, 1990).

Algeria puts a high emphasis on national economic security owing to the country's dependence on oil and gas earnings, the volatility of global oil prices, and the region's geopolitical dynamics, which are notorious for continual oscillations that need decision-makers in Algeria to be exceedingly attentive. Therefore, Algeria faced significant economic challenges after its independence in July 1962, including the development of an independent fiscal and monetary authority as well as the construction of sound economic foundations. The major purpose was to assure the provision of food security while simultaneously encouraging industrial and agricultural diversity. The nation conducted a number of reform programs throughout the communist period, subsequently adjusting to a market economy when it appeared in the early 1990s, and finally shifting into a phase of economic take-off and integration into the global market after 2000. Despite Algeria's enormous natural resources and coastline, the country's economy is subject to external shocks, notably swings in the global oil market, as well as internal pressures like population growth and unemployment. Addressing these problems is vital to attaining economic resilience and long-term sustainability.

This research seeks to examine the association between climate change indicators and inflation in Algeria. This relationship highlights the extent to which individuals' purchasing power is affected, which is a crucial indicator of economic security. The study makes use of a contemporary standard approach, namely quantile regression, to examine the association between climate change indicators in Algeria (average temperatures and precipitation percentage) and inflation in the country.

Many recent studies shed light on the nexus between climate changes and inflation pressures. These papers shed lights on how this relationship affect economic stability and national security as a sign of general nations stability.

Using local projections for 1970—2020, S. Cevik & J. Jalles (2023) find that climate disasters significantly affect inflation and growth, with heterogeneous and sometimes opposing effects. These impacts differ by disaster type and are far stronger in developing economies, reflecting weaker fiscal capacity and greater long-term economic scarring. N. Abidi et al. (2024) developed a theoretical model and empirical evidence showing that climate shocks, mainly via food prices, complicate inflation control and weaken monetary policy transmission in ME&CA economies.

C. Nickel et al. (2023) found that projected warming up to 2035 raises annual food and headline inflation. Furthermore, it amplifies the inflationary impact of heat extremes, implying persistent upward pressure on price stability.

Another work by A. Budebes et al. (2025) reveals that abnormal weather shocks have a delayed but statistically significant impact on CPI. Additionally, they found particularly strong effects on food prices in GCC economies. Using ARDL and cointegration tests, work by M. Sithole (2025) results denote that rising temperatures and CO₂ emissions exert significant short- and long-run inflationary pressures, through food and energy channels.

Qi C. (2025) provides country-level evidence that climate change affects inflation via central bank interest-rate responses. Furthermore, the results show other impacts as food supply disruptions and pricing behavior. In a recent study, J. Iliysu et al. (2023) employ an SVAR model using monthly data (2002—2020) for Egypt, Nigeria, and South Africa. They find climate change lowers real output and raises food and consumer inflation. Particularly, the strongest effects are in Nigeria and South Africa, and food prices are most affected overall.

THE ECONOMIC AND NATIONAL SECURITY CONDITIONS IN ALGERIA

Studying the reality that characterizes the national security and the Algerian economy requires addressing a number of crucial concepts and facts. By analyzing the data, we can study the relationship between Algerian national security, its causes, and basic requirements, as well as the economic aspects affected by comprehensive state policies. All of the above allows building models that achieve results to help decision-makers in Algeria to scale up their strategies.

Economic Diversification and Dependence on Hydrocarbons. It is incontrovertible truth that Algeria is reliant on oil and gas income, which accounted for 86% of exports. Through many changes, Algeria has pushed measures to diversify the economy. These efforts were embodied in many development projects targeting agriculture and industry before 1990. Then improvements in public finance and monetary policy in line with the monetary and credit legislation 90-10. During the period 1990—2000, Algeria witnessed a rich transition phase towards a market economy with the support of foreign institutions (IMF and World Bank). After 2000, the nation adopted efforts to enhance non-hydrocarbon exports and the growth of the private sector. But following the covid-19 crisis, the most crucial measures achieved by Algeria in developing technological underpinnings for the success of the project have been consolidated. The government's aim includes strengthening the investment climate and boosting entrepreneurship to lessen dependency on oil and gas.

Youth Unemployment and Demographic Dynamics. Algeria's unemployment rate has considerably fallen in recent years, showing excellent labor market advances brought about by the Algerian government's initiatives introduced after 2000. In 2023, the unemployment rate was 11.81%, a 0.62% decline from the previous year's level of 12.44%. The trend continued, with a 1.17% decline in 2022 from

13.61% in 2021. In a similar vein, 2021 showed a 0.43% decline from 2020's average of 14.04%. Additionally, 2020 showed a 1.76% gain over 2019, demonstrating the volatility prior to the constant growth¹.

National Vision and Development Plans. A comprehensive framework for reaching sustainable development via structural improvements, greater governance, and enhanced resilience in important areas like industry, education, and agriculture is defined in Algeria's Vision 2030. Furthermore, Algeria intends to develop these sectors boost economic diversification and minimize dependency on hydrocarbons. Algeria seeks to enhance productivity and generate employment by supporting small and developing enterprises to assist the economy, prioritizing innovation, and fostering a competitive business environment. To boost trade, pull in investment, and accomplish long-term economic stability, the country also aligns its policies with regional integration plans, such as the African Continental Free Trade Area (AfCFTA).

Economic Security and External Shocks. Algeria is experiencing tremendous problems in light of the crises of global oil price volatility and several external economic shocks. The decline of oil prices in 2014 also led to an extreme funding problem when the income control fund ran out in October 2017. In addition to the economic effects of the COVID-19 pandemic, which expressed itself in rises in expenditures for immunizing persons against the epidemic. These incidents underscored the necessity for economic diversification and financial flexibility to secure permanent funding of the economy. In response, the national development plan stresses energy transformation and strengthening financial management by updating the Organic Law of Finance in 2018 and the Accounting and Management Law (Law 23-07) of Finance in 2023. Key initiatives include increasing the use of renewable energy, boosting efficiency in public expenditure, expanding income streams beyond hydrocarbons, strengthening local goods, and developing companies. These policies aimed at minimizing dependency on unpredictable oil markets, encouraging sustainable development, and enhancing Algeria's capacity to handle future global economic problems.

Regional and Global Context. Algeria is a prominent player in Africa and the Arab world owing to its geopolitical position and richness of natural resources, including oil, gas, and other minerals. Its strategic position at the junction of the Middle East, Africa, and Europe enhances its importance in the regional energy and commerce economies. To safeguard its economic and national security, Algeria focuses on actions aimed at sustaining government and eliminating corruption. Furthermore, the government has as its major objective the leveraging of its natural richness and strategic relationships to promote economic diversification, boost regional integration, and consolidate its worldwide position.

Climate change indicator. Region Changes in climatic patterns (temperatures, rainfall levels and unpredictability, sea level rise, etc.) pose physical dangers

¹ Algeria Unemployment Rate. *macrotrends*. 2024. URL: <https://www.macrotrends.net/global-metrics/countries/dza/algeria/unemployment-rate> (assessed on: 12.12.2024).

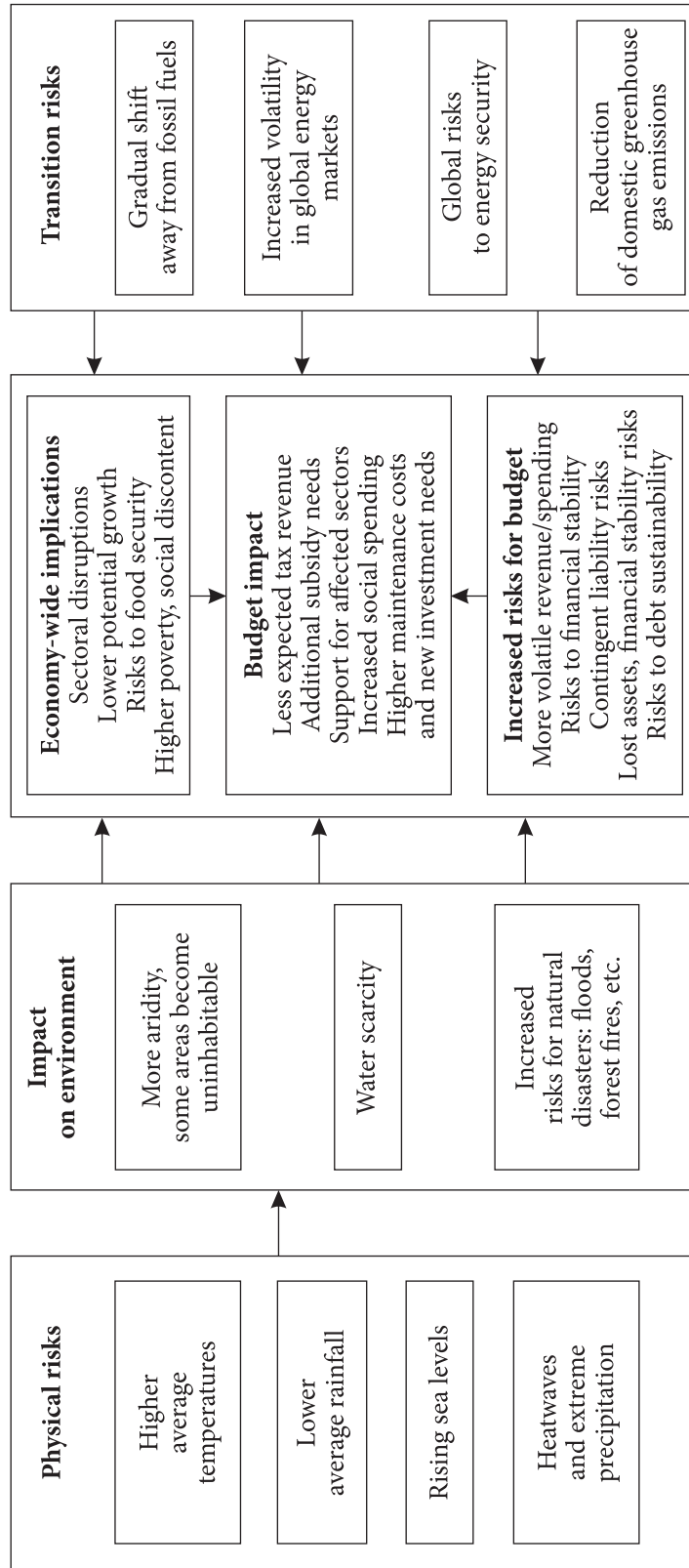
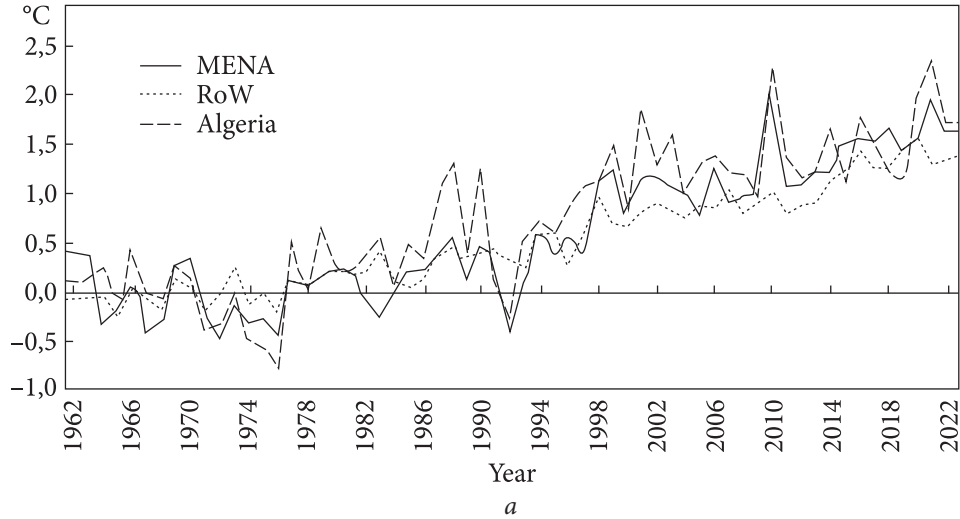


Fig. 1. Climate change: risks for the economy and for public finances
 Source: Harb, Nashin, 2024, p. 4.

Average temperatures in Algeria and the MENA have been rising at a faster pace than in the rest of the world



Average temperatures in Algeria are likely to continue rising in the coming decades

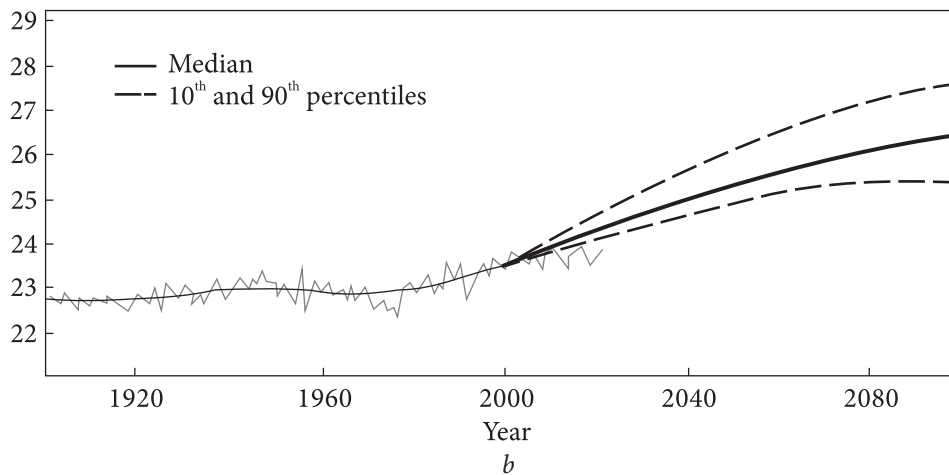
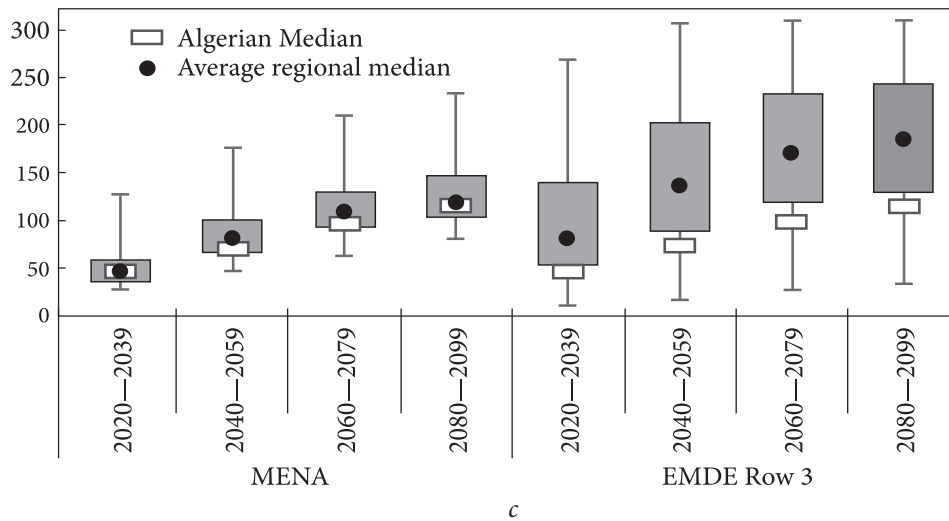


Fig. 2. Algeria: historical and projected average temperatures. All projections are under the SSP2—4.5 scenario: *a* — annual surface temperature change, 1962—2022 (change relative to the 1951—1980 baseline). This indicator presents the mean surface temperature change during the period 1961—2022, using temperatures between 1951 and 1980 as baseline; *b* — Algeria: projected mean-temperature, 1920—2080 (30 years averages, anomalies to 1985—2014). The black line represents row; *c* — warm-Spell Duration Index. The grey box represents the 10 and 90 percentiles and the whiskers the minimum and maximum; *d* — maximum temperature of more than 35 °C (projection). (See also p. 78).
 Source: Harb, Nashin, 2024, p. 7.

that may impair economic activity, assets, and human populations. Transition risks are produced by changes in how domestic and international economic players behave due to the transformation to a low-carbon economy and the related

Heat waves are likely to become longer and occur more frequently



Average temperatures in Algeria are likely to continue rising in the coming decades

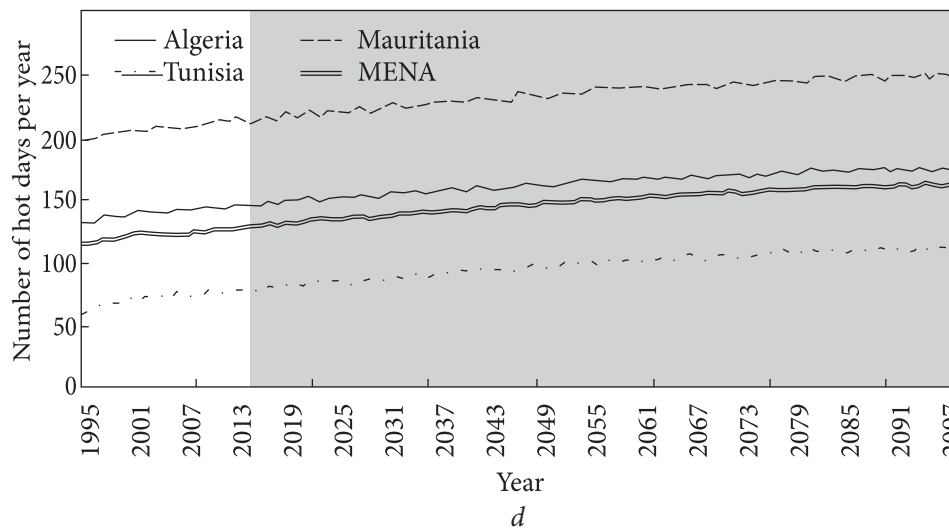


Fig. 2. The end.

changes in markets, rules, regulations, and technological and global contexts (Harb, Nashin, 2024) (Fig. 1).

The SSP2-4.5 scenario, which assumes modest global mitigation efforts to decrease CO₂ emissions, is represented in Fig. 2, coupled with historical and forecast temperature rises in Algeria. Since 1962, average temperatures in Algeria and the MENA region have climbed more swiftly than the world average, according to the data. This is proven by the considerable changes in Algeria's annual surface temperature. The average temperature in Algeria is likewise anticipated to climb continuously until 2080, suggesting that this warming trend will continue. Drought will become more common, and the chance of drought will grow due to this warming.

As evidenced by the Warm Wave Duration Index, which estimates lengthy periods of high heat that transcend historical limits. These results underline Algeria's extreme susceptibility to climate change.

Moreover, Algeria's hot days exceeding 35 degrees Celsius are anticipated to climb dramatically, outperforming those in bordering North African and Middle Eastern countries like Tunisia and Mauritania. Over time, Algeria may endure over 250 days of extreme heat yearly. Algeria's public health, water resources, and agriculture may face considerable hurdles consequently. All of the aforementioned presents a severe danger to Algeria's national security, as it stresses how urgently appropriate climate adaptation measures must be put in place to reduce the negative repercussions on diverse businesses. Algeria should also prioritize investment in climate-smart agriculture, renewable energy, and sustainable water management boost climate resilience. These steps will be vital for guaranteeing the long-term environmental sustainability of the nation and sustaining its socio-economic stability in the face of growing climate hazards.

DATA AND TOOLS

In the current section of our research, we will discuss numerous economic indicators that constitute a measure of economic security and thus national security. As well as numerous interactions and linkages between them. Furthermore, we shall assess the impact of AVTEMP (Average Temperature) and AVPERCIP (Average Precipitation) on inflation in Algeria. At its heart, the standard process is based on three primary variables that use Quantile Regression, a novel standard method developed by R. Koenker, K. Hallock (2001). Table 1 shows the various variables, their sources and nature.

Our model might be expressed as follows:

$$Q_y(\tau|X) = \beta_0(\tau) + \beta_1(\tau) \cdot AVTEMP + \beta_2(\tau) \cdot AVPERCIP + \beta_3(\tau) \cdot Z + \dots + \epsilon(\tau),$$

where $Q_y(\tau|X)$ is the conditional τ^{th} quantile of inflation given covariates X ; $\beta_0, \beta_1(\tau), \beta_2(\tau)$ and $\beta_3(\tau)$ are quantile-specific coefficients; Z denotes additional included economic security variables; $\epsilon(\tau)$ is the quantile-specific residual.

Table 1. Variables characteristics

Variables	Designation	Type	Data type	Source
AVTEMP	Average Temperature (Celsius)	Independent (regressor)	Annual	URL: https://tradingeconomics.com
AVPERCIP	Average Precipitation (mm)	Independent (regressor)	Annual	URL: https://tradingeconomics.com
INF	Inflation rate percent	dependent	Annual	URL: https://tradingeconomics.com

Source: created by authors.

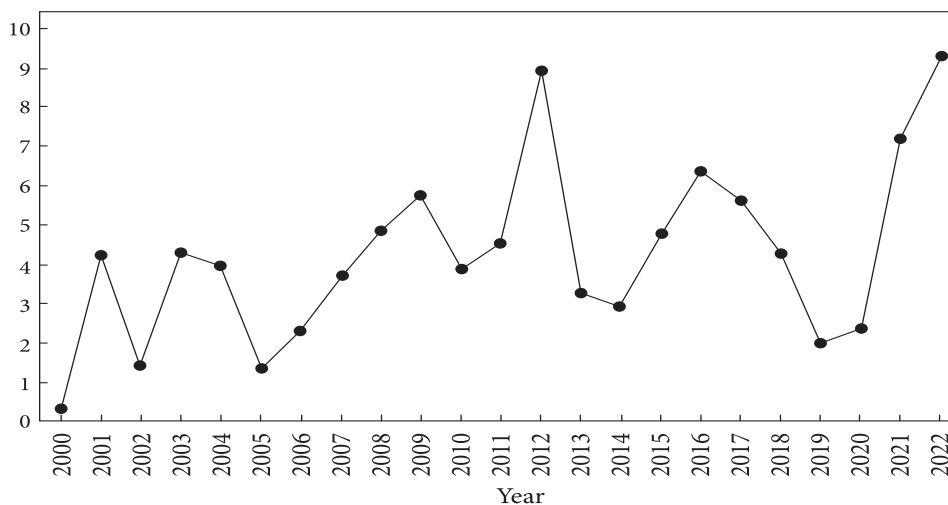


Fig. 3. Inflation trend in Algeria (2000—2022), %
 Source: URL: tradingeconomics.com (assessed on: 29.10.2025).

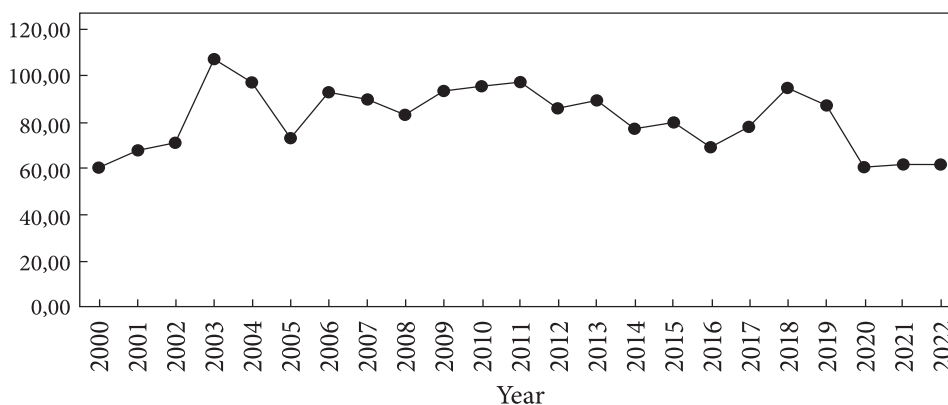


Fig. 4. Average precipitation in Algeria (2000—2022), mm
 Source: URL: tradingeconomics.com (assessed on: 29.10.2025).

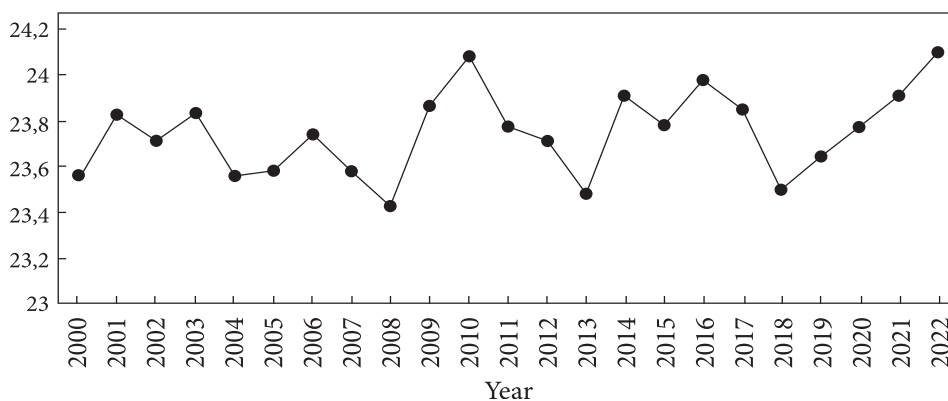


Fig. 5. Average temperature in Algeria (2000—2022), °C
 Source: URL: tradingeconomics.com (assessed on: 29.10.2025).

This allows for estimation of the effects of AVTEMP and AVPERCIP (and other variables) on different points of the conditional inflation distribution, such as the lower or upper tails, not just the mean.

ALGERIAN ECONOMIC AND CLIMATIC SITUATION

Fig. 3 depicts a variety of movements in economic indices, notably inflation rates, between 2000 and 2002. After 2006, inflation rates ranged between 2 and 8%. Inflation hit 11% in 2012, and from 2017 to 2022, inflation rates increased discernibly and consistently, finally reaching a steady level of 10.3% in 2022.

Fig. 4 and Fig. 5 demonstrate the climate variable behavior in Algeria from 2000 to 2022. In 2003, there was a 1.4% increase in temperature, followed by a large 1.3% decrease in 2005. The era was characterized by a varied pattern of decline and climb, with the greatest growth rates of 1.8% in 2009 and 2014.

During the span of time between the years 2000 and 2006, there was a known progressive rise in the average rainfall, which ranged from 63 millimeters to 98 millimeters on average. After this time period, the rates of rainfall were characterized by a relative rise until the year 2014, and then a progressive reduction was recor-

Table 2. 0.25 Quantile Regression Results

INF	Coefficient	Std. err.	<i>t</i>	<i>p</i> > <i>t</i>	95% conf	Interval
AVTEMP	3.8331	2.3728	1.62	0.122	-1.1166	8.7828
AVPERCIP	0.0549	0.0321	1.71	0.103	-0.0121	0.1219
_const	-93.0284	57.0204	-1.63	0.118	-211.9711	25.9141

Source: Stata17 output.

Table 3. Quantile 0.50 (Median Regression) Results

INF	Coefficient	Std. err.	<i>t</i>	<i>p</i> > <i>t</i>	95% conf	Interval
AVTEMP	3.8040	3.5087	1.08	0.291	-3.5150	11.1231
AVPERCIP	0.0165	0.0475	0.35	0.732	-0.08265	0.1157
_const	-87.5493	84.3158	-1.04	0.311	-263.4292	88.3305

Source: Stata 17 output.

Table 4. Quantile 0.75 Regression Results

INF	Coefficient	Std. err.	<i>t</i>	<i>p</i> > <i>t</i>	95% conf	Interval
AVTEMP	2.2297	4.6323	0.48	0.635	-7.4331	11.8926
AVPERCIP	-0.0601	0.0627	-0.96	0.349	-0.1910	0.0707
_const	-42.4082	111.316	-0.38	0.707	-274.609	189.7929

Source: Stata 17 output.

ded until the year 2017, when the average value reached 69 millimeters. The year 2018 saw the recording of a great height of 95.1 millimeters. In the year 2022, it leveled out at a value of 61.96 millimeters.

RESULTS DISCUSSION

Inflation is a crucial indicator of economic security and, by extension, national security. Using the Stata 17 program and the Quantile regression model with three different regression strategies (0.25, 0.50, and 0.75), we will examine different scenarios to determine the nature of the relationship between climate-specific changes and inflation.

1. Quantile 0.25

Model Fit: The Pseudo $R^2 = 0.1721$ suggests a limited explanatory capability, indicating that the model accounts for roughly 17.21% of the variability in INF at the 25th quantile.

Coefficients:

- AVTEMP: Coefficient = 3.8331, $p = 0.122$. Suggests a positive association, but it is not statistically significant at the 5% level;
- AVPRECIP: Coefficient = 0.0549, $p = 0.103$. Indicates a small positive effect, but also not statistically significant;
- Constant: -93.03 , $p = 0.118$. The constant term is not statistically significant.

2. Quantile 0.50 (Median Regression)

a-Model Fit: with a lower Pseudo $R^2 = 0.0709$, the explanatory power is reduced when compared to the 25th quantile.

b-Coefficients:

- AVTEMP: Coefficient = 3.804, $p = 0.291$. Positive effect, but not significant;
- AVPRECIP: Coefficient = 0.0165, $p = 0.732$. Minimal positive impact, not significant;
- Constant: -87.55 , $p = 0.311$. Not significant.

3. Quantile 0.75

a-Model Fit: the Pseudo $R^2 = 0.1984$ indicates a marginally improved fit compared to the lower quantiles, yet it remains constrained in its explanatory capacity.

b-Coefficients:

- AVTEMP: Coefficient = 2.2297, $p = 0.635$. Positive but not statistically significant;
- AVPRECIP: Coefficient = -0.0602 , $p = 0.349$. A small negative association, not significant;
- Constant: -42.41 , $p = 0.707$. Not significant.

KEY OBSERVATIONS

a) **Significance:** Across all quantiles, neither AVTEMP nor AVPRECIP has a statistically significant impact on INF. This suggests that these variables may not strongly influence inflation, or the sample size of 23 observations might be limiting the statistical power;

b) **Pseudo R²:** The low values across quantiles indicate that the models do not capture much of the variability in INF. Additional variables or a larger dataset may improve the model's fit;

c) **Direction of effects:**

- AVTEMP generally shows a positive but non-significant effect on INF;
- AVPRECIP has inconsistent effects (positive in lower quantiles, negative in higher), but these are not statistically robust.

CONCLUSION

Using the quantile regression model, the findings in the current research accounted for the influence of climatic factors on inflation. The quantitative regression also brought up the element that underlines the necessity for Algeria to create an economic strategy that guarantees flexibility and stability under diverse conditions. Influenced by elements such as average temperature (AVTEMP), inflation is a critical part of national security, since it directly influences the buying power of individuals, social stability, and the overall economic environment. To ensure economic security that results in national security, Algeria must emphasize economic diversification beyond dependency on oil and gas and establish a more balanced and healthy economy. This involves fostering climate-resilient agriculture policy, investing in renewable energy, and growing export-oriented businesses via small and medium-sized firms. These initiatives will lessen the risks presented by climatic variability and global economic shocks, lower the susceptibility of the economy to inflationary pressures, and strengthen its capacity to serve national security goals.

Furthermore, national economic security necessitates the improvement of Algeria's institutional framework and infrastructure. Investing in education, skill development, and infrastructure improvement increases productivity and economic competitiveness. More importantly, it establishes the framework for long-term growth and development. Transparent government and robust social safety nets are equally vital for safeguarding disadvantaged communities from the harmful consequences of inflation, promoting social cohesion, and decreasing inequality. This is an essential component of Algerian public policy as mentioned by A. Chibi et al. (2022, 2025), and Y. Zahaf & A. Chibi (2024), within the framework of macro policies coordination to establish national stability.

Algeria can build a more resilient and inclusive economy by linking economic policies with national security concerns including food security, energy independence, and regional trade integration. These measures will not only address current inflationary concerns, but will also provide long-term stability and security in the face of changing global and local forces.

Research directions. The possible implementation of climatic factors in traditional models in which inflation is a dependent variable, especially for Algeria. Future research could integrate climate indicators into conventional inflation models for Algeria by incorporating temperature shocks, rainfall variability, and disaster frequency. Emphasis should be placed on transmission channels through food prices, energy subsidies, fiscal and monetary policy responses. While accounting for structural vulnerabilities and limited adaptive capacity.

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КВАНТИЛЬНИЙ РЕГРЕСІЙНИЙ АНАЛІЗ
КЛІМАТИЧНОЇ ІНФЛЯЦІЇ ТА ЇЇ ВПЛИВУ НА ЕКОНОМІЧНУ
СТАБІЛЬНІСТЬ І НАЦІОНАЛЬНУ БЕЗПЕКУ АЛЖИРУ

Досліджено зв'язок між інфляцією і метеорологічними факторами в Алжирі, країні, економіка якої дуже чутлива до кліматичних змін і коливань на світовому енергетичному ринку. Підкреслено вагомий вплив екологічних змінних на зміни й коливання цін. Це пояснюється тим, що стихійні лиха, пов'язані з кліматом, трапляються частіше і можуть завдати шкоди економіці. Розглянуто вплив коливань середньої температури й кількості опадів на інфляцію, надано пропозиції щодо формування політики, спрямовані на підвищення стабільності економіки, зміцнення національної безпеки і стимулювання диверсифікації економіки.

Для дослідження впливу кліматичних факторів за різних рівнів інфляції використано квантильний регресійний підхід, що забезпечило більш точний аналіз порівняно з традиційними методами з використанням середнього. Результати показали, що середня температура має значний вплив на інфляцію, поки та є низькою, а із зростанням інфляції цей вплив зменшується. Це свідчить про те, що кліматичний тиск сильніший, коли ситуація є стабільною. Натомість середня кількість опадів має незначний і нерівномірний вплив у всіх квантилях, що підкреслює її обмежений вплив на інфляційні тенденції у Алжирі. Ці результати вказують на те, що розробникам політики слід надавати ризикам, пов'язаним з температурою, пріоритетного значення в ухваленні рішень. У майбутніх дослідженнях можна буде враховувати кліматичні фактори в традиційних моделях, у яких інфляція є залежною змінною, особливо для Алжиру.

Ключові слова: інфляція; національна безпека; зміни клімату; квантильна регресія; Алжир.

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