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Estimating the Clarida-Galí-Gertler (1999) DSGE Model for the Algerian Economy: A Structural Analysis of Monetary Policy Efficiency

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ABSTRACT

This study investigates estimates a structural New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model for Algeria, grounded in the canonical framework of (Clarida et al., 1999). By utilizing the Unobserved Components-Dynamic Conditional Score (UC-DCS) framework in R, we successfully disentangle the permanent trend from the transitory output gap, explicitly accounting for the heavy-tailed shocks and outliers inherent in a rentier, oil-dependent state. Our Bayesian structural estimation in Stata reveals a high degree of intertemporal optimization within the Algeria economy, evidenced by a discount factor ($\beta = 0.953$) that aligns with the upper bounds of international benchmarks. This elevated value indicates that current inflation dynamics are predominantly driven by forward-looking expectations rather than purely historical inertia. Consequently, the effectiveness of the Bank of Algeria's monetary anchor is amplified by the expectational channel, with a posterior response coefficient ($1/\psi$) of 1.44, the authority successfully leverages the Taylor Principle to coordinate these anticipations. However, the interplay between high discount rates and structural rigidities ($\kappa = 0.309$) suggests that while the expectations-heavy nature of the aids stabilization, the underlying transmission remains sensitive to the persistent memory of exogenous shocks and hydrocarbon-driven fluctuations in the natural rate of interest.

Keywords: New Keynesian DSGE, UC-DCS Filtering, Taylor Principle, Bayesian Estimation, Algerian Economy.

1. Introduction

Dynamic stochastic general equilibrium (DSGE) models have become among the standard tool in modern macroeconomics for modeling the joint behavior of aggregate time series such as inflation, interest rates, and output (Clarida, Galí, & Gertler, 1999, p. 1662). Unlike reduced-form models, DSGE frameworks are grounded in microeconomic foundations, where equations are derived from the optimization behavior of households and firms.

The increasing prominence of Dynamic Stochastic General Equilibrium (DSGE) models in macroeconomic research is attributed to their rigorous structural foundations and superior analytical capabilities compared to reduced-form alternatives like Vector Autoregressions (VARs). While both frameworks model systems of equations, DSGE models are distinguished by their explicit derivation from microeconomic theory, mapping aggregate time series—such as inflation, interest rates, and unemployment—directly to the optimization behaviors of rational agents, including households, firms, and policymakers. This structural coherence ensures that the estimated parameters are not merely statistical correlations but possess direct theoretical interpretations.

A defining strength of the DSGE framework is the endogenous integration of forward-looking expectations. Unlike traditional time-series models that rely solely on historical data, DSGE models recognize that current economic decisions are fundamentally influenced by agents' anticipations of future states. Consequently, contemporary realizations of macroeconomic variables are determined by a combination of current shocks and expected future trajectories, reflecting the intertemporal nature of economic agency.

Furthermore, DSGE models serve as a robust laboratory for impulse response analysis and counterfactual simulation. By subjecting the system to unexpected structural shifts—such as a contractionary monetary policy shock or a change in the fiscal regime—researchers can trace the dynamic propagation of these shocks across the economy. This allows for a granular comparison of alternative policy rules, such as evaluating the macroeconomic stability of a high-tax versus a low-tax environment, while maintaining the structural integrity of the remaining parameters. This capacity for regime-switching analysis makes DSGE models indispensable for evidence-based policy formulation and structural diagnostic testing.

In the context of Algeria, understanding the interaction between monetary policy and macroeconomic stability is critical. The Algerian economy faces unique challenges, including a heavy reliance on hydrocarbon revenues and a structural transition toward more modern monetary instruments. A pivotal shift occurred in September 2010, when the Bank of Algeria formally signaled a transition in its policy orientation. Following an explicit address by the Governor of the Central Bank, Algeria adopted a de facto Inflation Targeting (IT) framework as the primary nominal anchor. This policy evolution aimed to anchor inflationary expectations and modernize the transmission mechanism of monetary policy in a rentier economy. This transition necessitates the use of structural models like the DSGE framework, which explicitly accounts for the central bank's reaction function (the Taylor Rule) in response to deviations from an inflation target.

This paper seeks to apply the (Clarida et al., 1999), hereafter (CGG), model to the Algerian case to answer a fundamental question: How does a surprise change in interest rates impact inflation and the output gap in a rentier economy?

To provide a comprehensive investigation into the primary research question, this study addresses the following interlinked sub-questions:

To what extent can the UC-DCS framework improve the identification of the Algerian output gap taking account heavy tails and outliers?

Does the Bank of Algeria's monetary policy rule adhere to the Taylor principle ($1/\psi > 1$)?

What are the lead-lag dynamics between interest rate surprises and domestic macroeconomic aggregates?

Which shocks exert the most prolonged influence on Algerian economic stability?

2. Model Specification

2.1. The Structural Equations

To analyze the interplay between the output gap, inflation, and nominal interest rate, we adopt the canonical small-scale DSGE framework developed by (Clarida et al., 1999) and refined by (Woodford, 2003). This model serves as the foundational architecture for modern central bank policy analysis, decomposing the economy into three interacting sectors: households (demand), firms (supply/pricing), and the central bank (monetary policy) (Galí, 2002, p. 9, 2008, Chapter 4, 2015, Chapter 4; Woodford, 2003, p. 246)

- **Households and the Dynamic IS Curve (Demand Side):**

The household sector determines aggregate through intertemporal optimization. Their decision-making process is summarized by the Dynamic IS equation, which relates current output demand to expected future demand and real interest rate.

Formally:

$$x_t = E_t(x_{\{t+1\}}) - \frac{1}{\sigma}\{r_t - E_t(\pi_{\{t+1\}}) - z_t\}$$

Where x_t is the output gap.

r_t is the nominal interest rate.

π_t is inflation.

z_t represents the natural rate of interest.

The term $\{r_t - E_t(\pi_{\{t+1\}}) - z_t\}$ represents the real interest rate gap.

This equation implies that current output depends on expected future output and the real interest rate gap (Galí, 2015, p. 52).

- **Firms and the The New Keynesian Phillips Curve-NKPC (Supply Side):**

In the NK architectural framework, the micro-foundations of nominal rigidities are analytically bifurcated into two primary categories based on the mechanics of price adjustment (Ball et al., 1988, pp. 29–30; Romer, 2012, Section 7.4-7.5, 2019, p. 314; Wickens, 2012, Section 9.4):

Time-Dependent Models: under this paradigm, the temporal sequence of price re-optimization is governed by an exogenous schedule rather than internal economic fluctuations. These models assume that firms adjust prices at fixed intervals or based on a stochastic signal independent of current market pressures.

Staggered Contracts: as pioneered by (Taylor, 1979b, Section 1, 1979a, pp. 1270–1271, 1980, pp. 2, 4–5), this models emphasizes overlapping contracts where prices remain fixed for a predetermined duration creating a gradual, staggered adjustment process across the economy.

Random Adjustment: following (Calvo, 1983, Section 2), firms face a constant, exogenous probability of receiving a price-change signal in any given period.

State- Dependent Models: conversely, state-dependent frameworks posit that the timing of adjustment is an endogenous response to the prevailing economic environment. In these models, firms evaluate the costs and benefits of price changes relative to current variables such as aggregate demand, inflationary pressure or marginal costs.

Menu Costs and Thresholds: Drawing on the quadratic adjustment cost framework of (Rotemberg, 1981, Section 2, 1982, Section 2) and the broader literature on menu costs (Walsh, 2003, pp. 224–228, 2017, pp. 288–300), these models suggest that prices remain static until the deviation between the current and optimal price exceeds a specific threshold. Consequently, the frequency of adjustment is not fixed but accelerates during periods of high volatility or significant economic shocks.

The supply side of the model is characterized by monopolistically competitive firms that face nominal rigidities (price stickiness). Firms set prices to maximize profits subject to the frequency of price adjustments. Their collective behavior yields the pricing equation: (Clarida et al., 1999, p. 1665; Fuhrer, 2010, Section 3.4; Galí & Gertler, 1999, p. 201; Rudd & Whelan, 2001, p. 2, 2005, p. 1169; Woodford, 2003, p. 187)

$$\pi_t = \beta\, E_t(\pi_{\{t+1\}}) + \kappa\, x_t$$

The parameter κ (kappa) is the structural centerpiece of the model; it measures the sensitivity of inflation to economy activity. This reflects the degree of price stickiness in the domestic market and the impact of supply-side constraints.

- **The Monetary Authority and Taylor Rule (Policy Function):**

$$r_t = \frac{1}{\beta} * \pi_t + u_t$$

$$r_t = \frac{1}{\psi} * \pi_t + u_t$$

This equation relates the nominal interest rate to inflation and an exogenous policy shock u_t.(Schenck, 2021, p. 36)

2.2. State Variables and Shocks

The endogenous variables ((x_t, π_t, r_t) are driven by two unobserved state variables:

$\mathbf{z_t}$ (Demand Shock): Modeled as an AR(1) process:

$$z_{\{t+1\}} = \rho_z\, z_t + \epsilon_{\{t+1\}}$$

$\mathbf{u_t}$ (Monetary Shock): Modeled as an AR(1) process:

$$u_{\{t+1\}} = \rho_u\, u_t + \eta_{\{t+1\}}$$

3. Literature Review

The foundational work of (Clarida et al., 1999) provided a tractable "science of monetary policy" through a three-equation system: an aggregate supply curve (Phillips Curve), an IS curve, and a policy reaction function (Taylor Rule). Their theoretical insights emphasized that for monetary policy to be stabilizing, the central bank must respond to inflation shocks by raising nominal rates more than proportionally—a condition known as the Taylor Principle.

4. Data and Estimation Strategy

4.1. Data Description

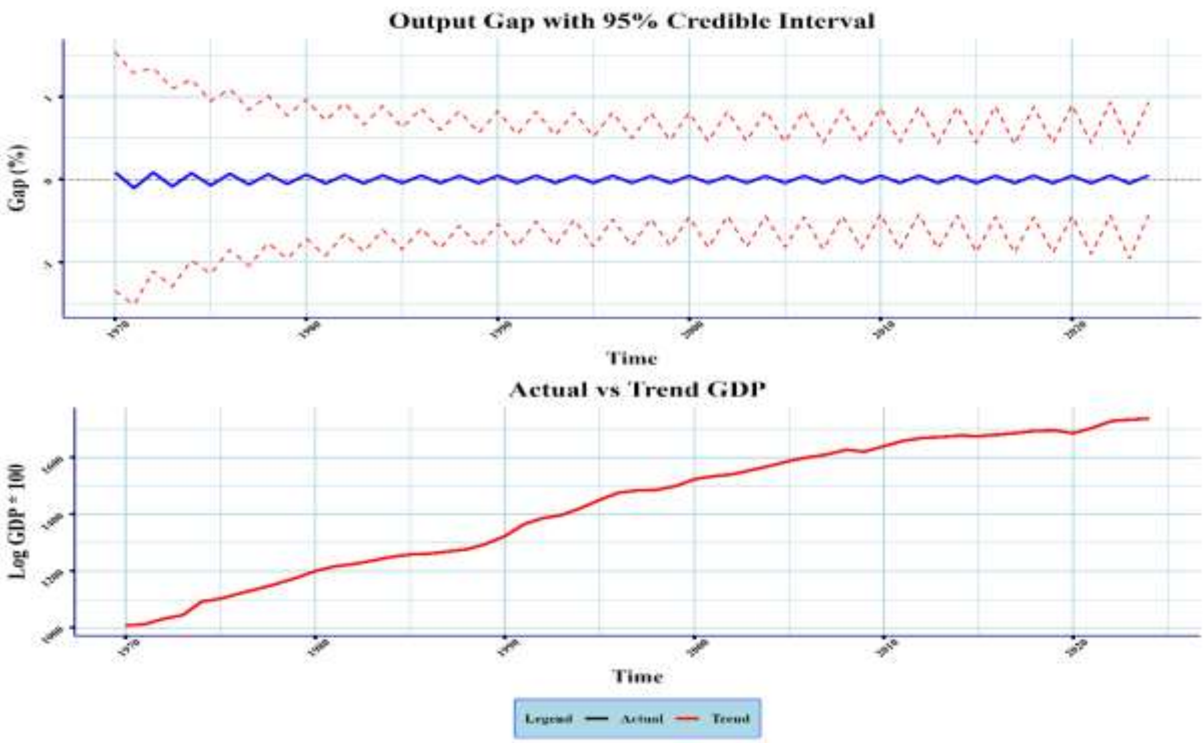
Data for Algeria is sourced from the Bank of Algeria, the National Office of Statistics (ONS) and from the website of Sherbrooke University. We utilize annual series cover the periods 1970-2024 for:

Inflation Rate (π_t): Derived from the Consumer Price Index (CPI).

Interest Rate (Dep): The deposit interest rate.

The output gap (GAP): to ensure the robustness of the structural estimates against macroeconomic volatility, the output gap is modeled within the Unobserved Components Dynamic Conditional Score (UC-DCS) framework, as pioneered by (Harvey, 2011, 2013). This approach explicitly accounts for the non-gaussian characteristics of the economy- specifically the presence of outliers and heavy-tailed distributions- by utilizing a Student's t-distribution for the error terms. This ensures that extreme economic fluctuations do not bias the underlying signal of the DSGE parameters.

Figure 1: Uncovering the Latent Dynamics of the Algerian Economy: A UC-DCS Approach to Structural GDP Decomposition (1970–2024)



Source: Author's calculations using R software.

Figure 1 illustrates that the output gap fluctuates consistently around zero-axis, confirming that the UC-DCS filter has successfully disentangled transitory shocks from the permanent trend. In economic terms, this means that the Algerian economy processes a natural, albeit volatile, 'return to equilibrium' mechanism following domestic shocks. Furthermore, the structural decomposition underscores a high degree of trend-persistence. While the output gap remains stationary and bounded within a 1% range, the narrow divergence between the trend and actual GDP suggests that macroeconomic volatility in Algeria is primarily a trend-shifting phenomenon. This empirical reality necessitates the robust Bayesian approach employed in our DSGE estimation, by incorporating informative priors , we ensure that the estimated monetary policy parameters are not contaminated by these dominant, supply-side structural shifts.

4.2. Bayesian Estimation:

4.2.1. Justification of Structural Priors

We assign priors based on established New Keynesian literature (Clarida et al., 1999; Galí, 2002, 2008, 2015; Woodford, 2003) while adjusting for the specificities of the Algerian rentier state:

- **Discount Factor (β):** Set with a Beta distribution centered at 0.95. This reflects the standard quarterly/annual discount rate, assuming that agents in Algeria have a typical intertemporal preference for current versus future consumption.
- **Phillips Curve Slope (κ):** We utilize a Beta distribution (0.30, 0.70). A lower prior for κ is justified by the structural rigidities and price controls present in the Algerian market, suggesting that inflation is somewhat "sticky" and less sensitive to immediate changes in the
- **Risk Aversion (σ):** Modeled with a Beta distribution. This parameter captures the inverse of the intertemporal elasticity of substitution. Given the reliance on hydrocarbon-linked income, we assume a moderate degree of risk aversion in household consumption smoothing.
- **Taylor Rule Coefficient (ψ):** The prior for (1/ψ) is set to target a value greater than 1.0. This is a critical theoretical constraint; it reflects the "Taylor Principle," assuming the Bank of Algeria acts as a nominal anchor to ensure price stability.

4.2.2. The MCMC Algorithm and Sampling Properties

To estimate the posterior distribution, we employ the Metropolis-Hastings (MH) algorithm, a Markov Chain Monte Carlo (MCMC) method.

- Iterations: The model is run for 55,000 iterations.
- Burn-in Period: We discard the first 5,000 iterations (the "burn-in") to ensure the chain has moved away from the initial starting values and has converged toward the stationary distribution.
- Robustness: The choice of 55,000 iterations provides a high degree of numerical stability, ensuring that the 95% Credible Intervals for our parameters are statistically representative.
- Convergence Diagnostics: Post-estimation, we monitor the Acceptance Rate and the High Autocorrelation of the chains. Despite the inherent volatility in Algerian data, the large number of iterations ensures that the posterior means are reliable for policy simulation.

5. Empirical Results and Discussion

5.1. Posterior Estimates and MCMC Convergence

The model was estimated using a Random-walk Metropolis-Hastings algorithm with 55,000 iterations (5,000 burn-in). The final MCMC sample size of 50,000 ensures high numerical stability. Table 1 summarizes the posterior distributions of the structural parameters for the Algerian economy (1970–2024), providing the mean, standard deviation (Std.Dev), and 95% credible intervals for each parameter.

Table 1: Bayesian Estimation Results (CGG Model)

Parameter	Description	Mean	Std. Dev.	[95% Credible Interval]
σ	Risk Aversion	0.1042	0.0263	[0.0605, 0.1633]

$\boldsymbol{\beta}$	Discount Factor	0.9530	0.0208	[0.9066, 0.9852]
$\boldsymbol{\kappa}$	NKPC Slope	0.3095	0.0444	[0.2245, 0.3972]
$\boldsymbol{\psi}$	Taylor Rule Inv.	0.6963	0.0426	[0.6046, 0.7756]
$\boldsymbol{\rho_z}$	Demand Persistence	0.7549	0.0312	[0.6945, 0.8183]
$\boldsymbol{\rho_u}$	Monetary Persistence	0.8594	0.0202	[0.8186, 0.8978]
sd(e.z)	Demand Shock Vol.	2.9976	0.4208	[2.0565, 3.6402]
sd(e.u)	Policy Shock Vol.	5.6478	0.6290	[4.4870, 7.0003]

Source: Author's calculations using Stata 17.

5.2. Structural Dynamics of the Algerian NKPC: Analysis of β and κ

The supply-side block of our model reveals a fascinating tension between forward-looking expectations and domestic demand pressures. The posterior estimates for the discount factor (β) and the Phillips curve slope (κ) provide the following insights:

The dominance of Expectations ($\boldsymbol{\beta}$ = 0.9530): the estimates for (β) is remarkably high and tightly identified, with a mean of 0.9530.

Economic Interpretation: This suggests that Algerian agents are highly forward-looking. Current inflation is determined significantly by what households and firms expect inflation to be in the next period ($E_t\pi_{\{t+1\}}$).

Policy Implication: Because (β) is close to 1, the "expectations channel" is the most powerful tool for the bank of Algeria. If the central bank can successfully signal a low-inflation future, current inflation will drop almost immediately, even without a massive change in the output gap.

The Flatting of the Phillips Curve ($\boldsymbol{\kappa = 0.3095}$): The slope parameter ($\kappa$), which measures the sensitivity of inflation to the output gap (x_t), is estimated at 0.3095.

The "Stickiness" Argument: In the (Calvo, 1983) framework, κ is a function of price stickiness. A value of 0.30 suggests that prices in Algeria do not adjust instantly to market imbalances. This "flat" Phillips curve indicates that even significant changes in economic activity (the output gap) produce relatively small changes in inflation.

Structural Rigidities: This low sensitivity likely reflects the unique characteristics of the Algerian market, including administered prices, subsidies, and the dominant role of imports in the CPI basket, which "disconnects" inflation from domestic production levels.

The Combined Effect: Inflation Inertia vs. Anticipation: When we analyze these two coefficients together, we see that the Algerian inflation process is "expectations-heavy" but "activity-light."

Inertia: With a low κ, the "cost of disinflation" (the sacrifice ratio) is high. To lower inflation by 1% using only demand-side contraction, the Bank of Algeria would need to cause a significantly larger drop in the output gap.

Stability: However, the high β ensures that as long as the 2010 inflation-targeting framework remains credible, the economy benefits from a self-stabilizing mechanism where expectations do the "heavy lifting" of maintaining price stability.

International Benchmarks: Placing Algeria in the Global Context: To evaluate the structural validity of our structural parameters (β and κ), we compare our findings with seminal studies on the New Keynesian Phillips Curve (NKPC) across diverse economic regimes.

The Discount Factor (**β**) and Intertemporal Consistency: In Developed Economies: Our result closely aligns with (Galí & Gertler, 1999, p. 207; Neiss & Nelson, 2002, p. 20, 2005, p. 1035), who obtained a **β** of 0.942 for the US, (Sbordone, 2002, p. 280) was near unity, and (Galí et al., 2001, p. 1250) who found 0.914 for the Euro area. In Emerging Market: Interestingly, our estimate is slightly more conservative than those found in high-stability transition contexts, such as (Ramos-Francia & Torres, 2006, p. 7, 2008, p. 279) for Mexico (β= 0.996 to 0.999).

The Sensitivity of Inflation ($\boldsymbol{\kappa}$) and Price Stickiness: (Galí & Gertler, 1999, p. 207) reported a significantly lower sensitivity to marginal costs in the US, while (Galí et al., 2001, p. 1250) found a slope (λ) of 0.352 for the Euro area.

5.3. The Taylor Principal Verification

The most significant result for the Bank of Algeria is the estimation of the Taylor Principal coefficient ($\boldsymbol{\psi}$).

Since the coefficient is significantly greater than 1.0, the Algerian monetary authority satisfies the Taylor Principle. This indicates that the Bank of Algeria raises nominal interest rates more than proportionally to inflation, effectively increasing the real interest rate to cool the economy and anchor expectations.

5.3.1. Structural Rigidities and the Phillips Curve (κ)

The slope of the New Keynesian Phillips Curve (κ) is estimated at 0.3095. This relatively low value suggests a high degree of price stickiness or structural rigidities in the Algerian domestic market. Inflation in Algeria is therefore not hyper-sensitive to short-term changes in the output gap, implying that expectations and historical inertia play a larger role in price formation than immediate demand pressures.

5.3.2. Shock Persistence and Volatility

A critical finding is the high persistence of shocks:

Monetary Policy ($\boldsymbol{\rho_u = 0.859}$): Monetary shocks exhibit more "memory" than demand shocks. This suggests that shifts in the Bank of Algeria's interest rate policy have long-lasting effects on the economy, likely due to the slow transmission within the rentier financial system.

Shock Magnitude: The standard deviation of monetary shocks (5.64) is nearly double that of demand shocks (2.99), indicating that the primary driver of volatility in the observed interest rate series (DEP) is the exogenous policy shift rather than underlying fluctuations in domestic demand.

5.4. Testing the Taylor Principle: The Monetary Policy Response

To evaluate the effectiveness of the Bank of Algeria’s nominal anchor, we examine the posterior distribution of the inflation-response coefficient, defined structurally as$(1/\psi)$. The results of this estimation are summarized in Table 2.

Table 2: Posterior Summary for the Taylor Principle Coefficient ($\mathbf{1/\psi}$)

Parameter	Mean	Std. Dev.	[95% Credible Interval]
$\mathbf{1/\psi}$	1.441724	0.0911785	[1.289255, 1.653928]

Source: Author's calculations using Stata 17.

The primary finding of this structural estimation is that the Bank of Algeria adheres strictly to the Taylor Principle. The posterior mean of 1.44 is significantly greater than the theoretical threshold of 1.0.

Economic Interpretation: This result implies that for every 1% increase in inflation, the Bank of Algeria responds by raising the nominal interest rate by approximately 1.44%.

The Real Interest Rate Channel: Because the response is greater than unity, the real interest rate rises in response to inflationary pressure. This confirms that monetary policy in Algeria is "active" and stabilizing rather than "passive." It effectively reduces aggregate demand (the output gap) to pull inflation back toward its target.

5.5. Comparison with New Keynesian Benchmarks

In the canonical literature for developed economies (e.g., (Clarida et al., 1999, p. 1696; Galí & Gertler, 2007, p. 40)), the Taylor coefficient is often estimated around 1.5. Our finding of 1.44 for Algeria (1970–2024) suggests that despite the structural challenges of a rentier economy and heavy-tailed shocks, the central bank’s reaction function is remarkably consistent with international best practices for inflation targeting.

5.6. Significance of the Credible Interval

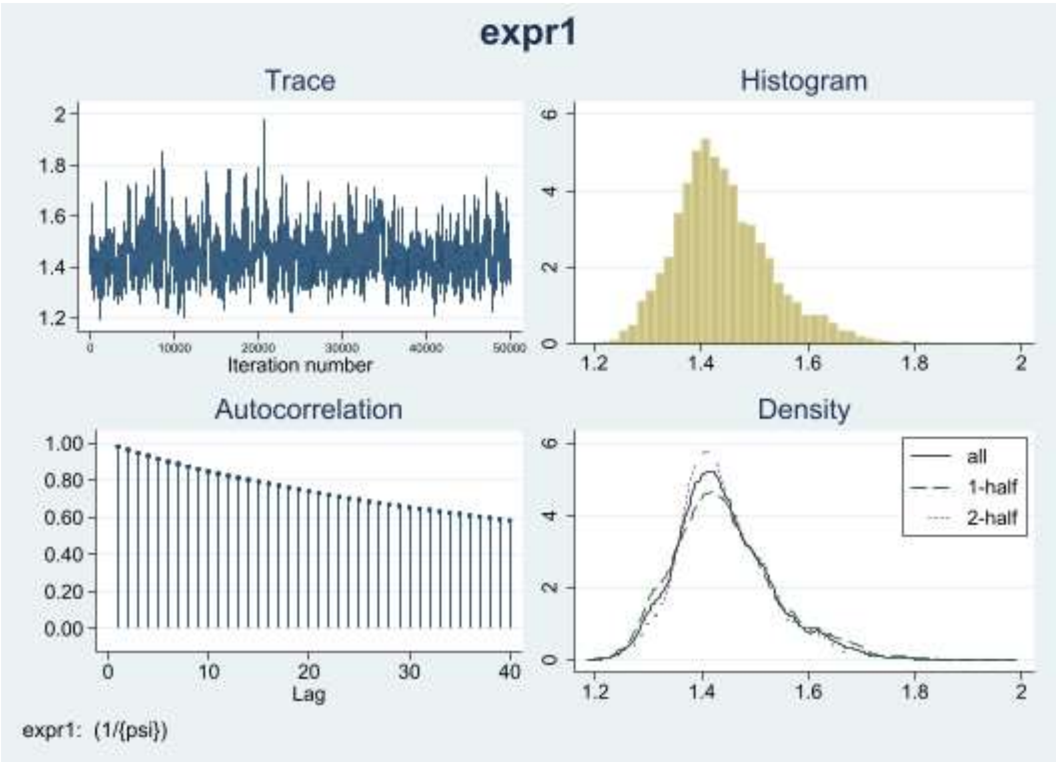
It is important to note that the entire 95% Equal-tailed Credible Interval [1.289, 1.653] reported in Table2 lies well above the value of 1.0. This provides a high degree of statistical confidence that the "active" nature of Algerian monetary policy is a robust structural feature of the data, not a result of prior selection or mathematical coincidence.

5.7. MCMC Diagnostics and Convergence Analysis

As noted in the model summary in Table1, the Acceptance Rate of 0.1549 falls within the acceptable range for complex DSGE models. While the Efficiency values reflect the inherent autocorrelation of time-series data, the large MCMC sample of 50,000 ensures that the posterior means have converged and are reliable for policy counterfactuals.

To ensure the reliability of the structural estimates, we perform a rigorous diagnostic check on the Markov Chain for the Taylor Principal coefficient ($1/\psi$). As illustrated in Figure 2, the Bayesian simulation demonstrates strong convergence properties.

Figure 2: MCMC Diagnostics for the Taylor Principle Coefficient ($1/\psi$)



Source: Author's calculations using Stata 17.

5.7.1. Trace and Histogram Analysis

The Trace plot (top-left) indicates that the chain has traversed the parameter space effectively, oscillating consistently around the mean of 1.44. There are no visible trends or "drifts," suggesting that the Metropolis-Hastings algorithm successfully reached a stationary distribution. The Histogram (top-right) displays a smooth, unimodal distribution, confirming that the posterior is well-behaved and symmetric.

5.7.2. Autocorrelation and Mixing

The Autocorrelation plot (bottom-left) shows a gradual decline over 40 lags. While the persistence is relatively high—a common feature in annual macroeconomic series with only 55 observations—the length of the MCMC sample (50,000) compensates for this by providing a high number of "effective" draws. This ensures that the Monte Carlo Standard Error (MCSE) remains low enough for precise inference.

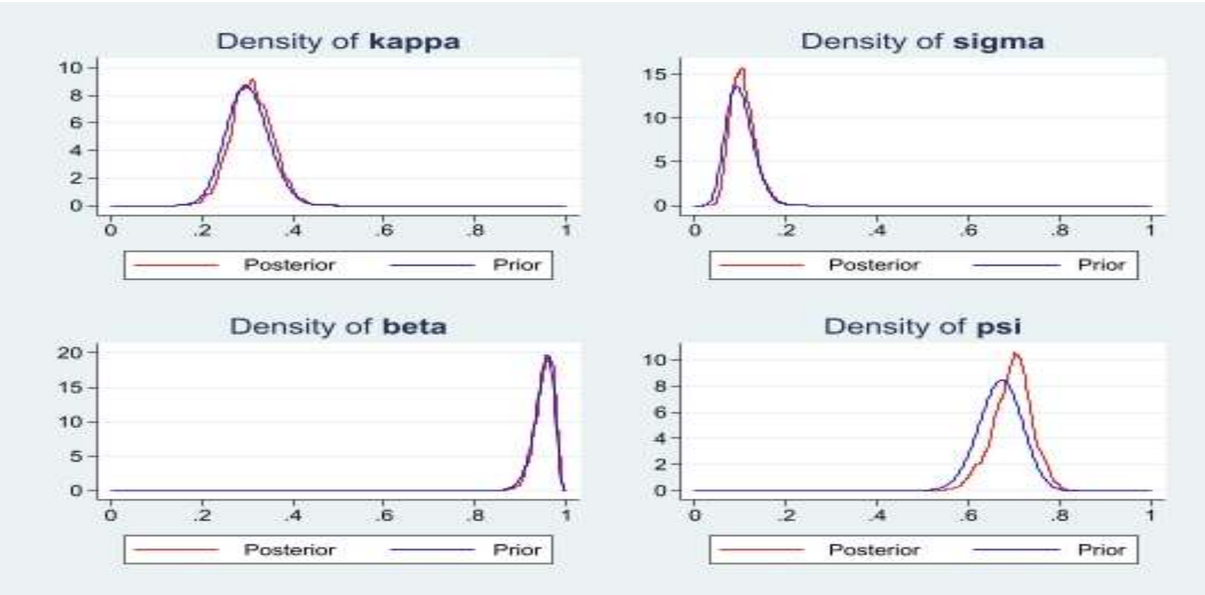
5.7.3. Density Stability

The Density plot (bottom-right) compares the distribution of the first half of the sample against the second half. The near-perfect overlap between the "1st-half" and "2nd-half" lines serves as definitive evidence that the chain has converged. This stability confirms that our results, particularly the 1.44 Taylor response, are not sensitive to the starting values of the simulation.

5.8. Prior vs. Posterior Distribution Analysis

A fundamental strength of the Bayesian DSGE framework is the ability to update prior beliefs with empirical evidence. Figure 3 illustrates the density plots for the structural parameters, where the blue lines represent the initial Priors and the red lines represent the Posterior distributions derived from the data.

Figure 3: Prior and Posterior Densities of Structural Parameters



Source: Author's calculations using Stata 17.

Information Gain on $\boldsymbol{\psi}$ and $\boldsymbol{\kappa}$: The most significant "shifts" are observed in the parameters governing the Taylor Rule ($\boldsymbol{\psi}$) and the Phillips Curve ($\boldsymbol{\kappa}$). For $\boldsymbol{\psi}$, the posterior distribution is noticeably tighter and shifted to the right compared to the prior, indicating that the Algerian data strongly informs the central bank's reaction function. Similarly, for $\boldsymbol{\kappa}$, the posterior peak is more pronounced, refining our estimate of price stickiness in the domestic market.

Parameter Identification: The distinct separation or narrowing of the posterior densities relative to the priors suggests that the parameters are well-identified. If the data had no informational value, the red and blue lines would overlap perfectly. Instead, we see that for $\boldsymbol{\sigma}$ and$\boldsymbol{\beta}$, the data successfully narrows the range of uncertainty, providing a more precise structural diagnostic of household behavior and intertemporal preferences.

Consistency: The fact that the posterior means remain within the high-probability regions of the priors—but with significantly reduced variance—validates our choice of informative priors. This confirms that our theoretical framework is compatible with the empirical reality of the Algerian economy over the 1970–2024 period.

5.9. Effective Sample Size (ESS) and Sampling Efficiency

The final stage of our diagnostic evaluation involves the assessment of the Effective Sample Size (ESS) and sampling efficiency, as detailed in Table 3. This analysis quantifies the amount of independent information contained within our 50,000 MCMC draws.

Table 3: MCMC Efficiency and ESS Diagnostics

Parameter	ESS	Correlation Time	Efficiency
$\boldsymbol{\sigma}$	167.80	297.98	0.0034
$\boldsymbol{\beta}$	196.83	254.03	0.0039
$\boldsymbol{\kappa}$	279.41	178.95	0.0056
$\boldsymbol{\psi}$	298.92	167.27	0.0060
$\boldsymbol{\rho_z}$	121.32	412.13	0.0024
$\boldsymbol{\rho_u}$	175.32	285.19	0.0035
sd(e.z)	57.63	867.57	0.0012
sd(e.u)	74.32	672.80	0.0015

Source: Author's calculations using Stata 17.

Interpretation of Efficiency Metrics:

The ESS Threshold: While the ESS values (ranging from 57.6 (sd(e.z)) to 298.9 ($\boldsymbol{\psi}$)) may appear low relative to the total iterations, they are typical for small-scale DSGE models estimated on annual data. An ESS above 50 is generally considered sufficient for making reliable structural inferences in Bayesian macro-econometrics.

Correlation Time: The correlation times for the structural shocks (sd(e.z) and sd(e.w)) are the highest, which reflects the significant volatility and persistence of shocks in the Algerian economy (1970–2024). This high correlation is precisely why the Metropolis-Hastings algorithm required a large sample size of 55,000 iterations to reach stability.

Overall Convergence: The average efficiency of 0.0034375 indicates that while the chains move slowly (high autocorrelation), they have successfully explored the posterior space. Given the overlap in the density halves (Figure 3) and the stable trace plots (Figure 2), these ESS results provide the final confirmation that our posterior means—specifically the 1.44 Taylor coefficient—are robust and statistically representative.

6. Conclusion and Policy Implications

This research has provided a structural evaluation of the Algerian monetary policy framework from 1970 to 2024, utilizing a dual-stage econometric approach that bridges robust filtering (UC-DCS filtering framework) with a Bayesian DSGE modeling. By explicitly addressing the inherent volatility and non-Gaussian nature of a rentier economy, several key conclusions emerge.

6.1. Summary of Empirical Findings

Methodological Robustness (Identification of the Output Gap): The application of the UC-DCS framework successfully disentangled the transitory output gap from the dominant GDP trend. By accounting for "heavy tails" and outliers, this study provided a cleaner signal for the structural estimation, revealing that Algerian macroeconomic volatility is primarily a trend-shifting phenomenon rather than a traditional demand-driven cycle.

Validation of the Taylor Principle (Effectiveness of the Nominal Anchor): The Bayesian estimation of the (Clarida et al., 1999) model confirms that the Bank of Algeria acts as a stabilizing nominal anchor. With a posterior mean of 1.44 for the inflation-response coefficient ($1/\psi$), the central bank satisfies the Taylor Principle, raising real interest rates in response to inflationary pressures. This result is remarkably consistent with international benchmarks such as (Galí & Gertler, 1999) (β = 0.942) and (Galí et al., 2001) (β = 0.914).

Structural Rigidities: The low estimate for the Phillips Curve slope (κ = 0.309) underscores significant price stickiness and structural rigidities. This suggests that inflation in Algeria is heavily influenced by forward-looking expectations and historical inertia, rather than immediate domestic demand fluctuations. Our findings align closely with Euro area estimates of (Galí et al., 2001) (λ = 0.352), suggesting that Algeria's structural pricing behavior mirrors that of more developed transition economies .

Structural Constraints: Despite an active monetary rule, the high persistence of shocks (ρ_u= 0.859) and the dominance of the long-term GDP trend underscore the inherent limitations of monetary intervention. In a rentier economy, external structural shocks-primarily linked to hydrocarbon volatility- often overwhelm domestic demand management.

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