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Parallel Exchange Rate and Money Demand in Algeria (1990–2024)

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Abstract :
This study examines how fluctuations in Algeria's parallel exchange rate affect broad money demand (M2). The topic is particularly relevant in Algeria's foreign-exchange setting, which is characterized by regulatory controls and a dual exchange-rate system (official and parallel), with a gap between the two rates widening notably since the 1994 economic reforms. Our analysis relies on quarterly data covering 1990–2024. To estimate the relationship between money demand and its determinants, the paper employs an Autoregressive Distributed Lag (ARDL) approach, which accommodates mixed orders of integration and allows a clear distinction between short-run dynamics and long-run relationships. The findings indicate that movements in the parallel exchange rate are significantly associated with short-run changes in real money demand, whereas the long-run relationship is mainly driven by fundamentals such as income and the price level. Diagnostic and stability tests support the adequacy of the estimated specification
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1- Introduction :

The money demand function is traditionally built on a set of core determinants, foremost among which is the level of income as a proxy for the volume of transactions and overall economic activity, together with the cost of holding money, which represents the opportunity cost and is usually captured by the interest rate. In advanced economies with developed financial markets, interest rates play a central role in shaping decision-making. In contrast, in many developing economies, interest rates may not reflect the true return because of regulatory constraints, so inflation becomes a more suitable measure of the cost of holding money, as it captures the erosion of purchasing power and directly affects decisions regarding money balances.

Although income and the cost of holding money are central to explaining money demand, the theoretical role of the exchange rate has been highlighted since the early contributions of Mundell (1963), which opened the door to including it among the determinants of money demand. Much of the early applied literature, however, tended to rely on the official exchange rate as the available and recognized indicator in formal channels, an option that may be relatively consistent with environments characterized by institutional stability and greater liberalization of foreign-exchange markets.

Relying solely on the official rate is not always appropriate when this framework is applied to developing economies, especially in countries with foreign-exchange controls or where the authorities intervene to peg or steer the official rate away from market forces. In such cases, a single exchange rate does not emerge; instead, a dual system typically appears with an official rate and a parallel rate determined in the informal market. The parallel rate often reflects more clearly the underlying imbalances between the supply of and demand for foreign currency and the expectations of economic agents regarding the value of the domestic currency, and its fluctuations tend to capture the degree of uncertainty and shifts in confidence. This is even more pronounced in developing countries, where financial markets are shallow and formal alternatives for agents are limited, so relying only on the official rate leads to an incomplete reading of behavior and may result in misspecification of the estimated money-demand relationship.

In this context, subsequent literature has sought to underline the usefulness of using the parallel exchange rate in economies where a parallel currency market exists. Rather than treating it as a mere substitute for the official rate, it is employed as an indicator that more closely reflects market signals, a view supported by comparative evidence such as Bahmani-Oskooee (1996). Including this variable is therefore regarded as a complement to the traditional framework rather than a replacement, because it helps explain how developments in the informal foreign-exchange market push households and firms to rebalance their portfolios, reduce their holdings of domestic money, or increase hedging via alternative assets and foreign currencies.

Building on this, the present study focuses on examining the impact of fluctuations in the parallel exchange rate on money demand in Algeria. Specifically, it tests

whether movements in this rate generate a measurable effect and whether that effect differs between the short run and the long run. Accordingly, the study specifies the money-demand function by including real income as a proxy for the transactions motive, inflation as a measure of the cost of holding money in a developing economy, and the parallel exchange rate as a variable that captures the specific features of a dual exchange-rate market, the associated uncertainty, and the resulting changes in money-holding behavior

2. Previous studies

The literature emphasizes that the choice of the appropriate exchange-rate variable (official or parallel) is not a mere technical detail; it can fundamentally alter conclusions about stability and cointegration, particularly in environments where the official rate does not reflect market behavior. In this context, Arize and Shwiff (1998) offer a direct test of the question "which exchange rate should enter the money demand function?" using a sample of 25 developing countries. They compare a specification that includes the official rate with another that includes the black-market rate within a cointegration framework and conclude that the money-demand function using the black-market rate is often more appropriate in settings with exchange-rate controls and multiple rates. More specifically for countries where the parallel market dominates, Bahmani-Oskooee (1996) examines the case of Iran, arguing that relying only on the official rate can lead to an inaccurate money-demand function, since money-holding decisions are in fact influenced by the market-traded rate. The study shows that including the parallel (black-market) rate helps to explain economic agents' behavior under foreign-exchange restrictions.

Onafowora and Owoye (2005) incorporate the exchange rate (FX) into the demand for money (M2) as an indicator of expected currency depreciation. In practice, they measure FX by quarter-to-quarter changes in the exchange rate (domestic currency per dollar), which capture what agents observe as weakness in the domestic currency. They also add a composite variable (FR–FX) that combines the U.S. interest rate with expected depreciation of the domestic currency to represent the relative attractiveness of holding foreign versus domestic currency. Their results indicate a cointegrating relationship between M2 and its determinants in the five sample countries and show that the exchange-rate variable (through both indicators) is statistically significant, meaning that expectations of domestic currency depreciation are associated with a decline in demand for local money.

Bahmani-Oskooee and Techaratanachai (2001), in their study of Thailand, also highlight the link between exchange-rate fluctuations, inflationary conditions, and the behavior of liquidity and deposits, reflecting the sensitivity of agents' preferences to changes in the domestic currency's value.

For Turkey, Bahmani-Oskooee and Domac (2003) relate high inflation and exchange-rate depreciation to a growing preference for foreign-currency deposits. They construct a practical indicator measuring the ratio of foreign-currency deposits to the money stock or to domestic-currency deposits. The study finds that domestic currency depreciation and rising inflation are associated with a shift in saving and liquidity preferences toward foreign currency.

Darrat et al. (1996), in a study on Japan, show that the instability of the money-demand function can be linked to omitting variables that capture exchange-rate expectations. Structural stability tests (such as the Chow test and others) indicate that the model is more prone to instability when such indicators are excluded from the specification. The study constructs an indicator (CS) for expected exchange-rate changes based on purchasing power parity, measured by the inflation differential between Japan and the United States using wholesale price indices in the two countries. The coefficient on ΔlnCS is negative and statistically significant in the error-correction model, implying that rising expectations of a weaker domestic currency are associated with a decline in holdings of domestic money.

Some contributions show that the effect of the exchange rate on money demand may be asymmetric, in the sense that appreciations and depreciations need not have the same impact. In this regard, Bahmani-Oskooee and Gelan (2019) argue that exchange-rate effects in the money-demand function should not be assumed symmetric. They use the real effective exchange rate and treat its changes as shocks and expectations about the currency's value. To capture asymmetry, they decompose exchange-rate changes into two components, POS for appreciations and NEG for depreciations, and then test whether their effects on money demand differ. The results show that exchange-rate effects arise mainly in the short run in most countries and only translate into long-run effects in a few cases, suggesting that money-demand responses to exchange-rate volatility are often short-lived or contemporaneous.

From another angle, and beyond simply inserting official and parallel rates, Bahmani-Oskooee and Tanku (2006) analyze the black-market premium and the uncertainty associated with it as potential determinants of money-holding behavior. They show that a higher black-market premium can, in theory, generate two opposing effects: a precautionary/wealth effect that might increase demand for domestic money, and an expectation effect of further depreciation that may reduce it. Their empirical results indicate that the black-market-premium specification provides stronger statistical support than competing models.

Methodologically, the ARDL literature provides a strong case for adopting an approach that distinguishes between short-run and long-run dynamics under mixed orders of integration. Siddiki (2000), in a study on Bangladesh, uses ARDL and the bounds-testing procedure to demonstrate cointegration between money demand and its determinants, including inflation or interest rates, which underscores the suitability of this methodology in developing economies characterized by data limitations and mixed I(0)/I(1) time-series properties.

At the survey level, Sriram (2001), reviewing a large set of empirical studies, shows that money-demand instability can be related to factors such as financial liberalization, structural change, and capital-account openness, and that including context-specific variables—among them exchange-rate variables in open economies—can improve the performance of money-demand functions.

With respect to Algeria, Bouthelja and Batah (2015) directly examine which exchange rate should be included in the money-demand function: the official rate

(OEX) or the parallel rate (BEX) in an economy where both coexist because of foreign-exchange restrictions. Using quarterly Algerian data for 1975Q1–2009Q2, they find that including the parallel rate is more appropriate than the official rate: the coefficient on the official rate is not significant, whereas the parallel-rate coefficient is more significant and better explains money-demand behavior. Stability tests also indicate that the money-demand function is more stable when the parallel rate is used instead of the official rate.

Boucekkine et al. (2021), also on Algeria but using the official exchange rate, show that exchange-rate depreciation is associated with a decline in demand for domestic money, with the magnitude of the effect varying across monetary aggregates. Their results suggest that the effect is stronger for M1 and currency in circulation than for M2, indicating that transaction balances and cash hoarding respond more strongly to exchange-rate fluctuations than broader aggregates.

Overall, the literature shows that the choice of "which exchange rate to use" is not a secondary issue, especially when official and parallel rates coexist. Incorporating an indicator that reflects market-based fluctuations and agents' expectations yields a more accurate estimate of money demand. Many studies also favor methodologies that distinguish between short-run and long-run effects under mixed integration orders, which justifies the use of the ARDL framework in this study.

3. Methodology

Specifying the money-demand function carries particular importance in Algeria, given the institutional features of the money and foreign-exchange markets. Over the sample period, the Algerian economy has been characterized by continued state intervention in the foreign-exchange market and by regulatory controls, which have given rise to the coexistence of two exchange rates for the dinar (official and parallel). In such a setting, the official rate does not always reflect actual market behavior or agents' expectations, making it essential, when modeling money demand and its response to shocks, to include an indicator that captures developments in the informal foreign-exchange market.

In addition to the transactions variable, represented by real income, estimating the money-demand function requires including a variable that reflects the opportunity cost of holding money balances. Using an interest rate for this purpose does not appear appropriate in Algeria, given the limited development of financial markets and the weak ability of interest rates to reflect market conditions accurately. For this reason, the present study uses the inflation rate as a practical proxy for this cost. Accordingly, the money-demand function is specified in terms of real income, inflation, and the parallel exchange rate, in a way that is consistent with the economic and monetary environment in Algeria during the study period. Several alternative money-demand specifications were tested using different monetary aggregates (M1 and M2) and multiple exchange-rate measures (official and parallel) with the aim of selecting the model that best fits the Algerian context. The specification based on broad money demand (M2) and the parallel exchange rate yielded more stable and statistically meaningful results than the alternatives, and the analysis therefore concentrates on this version.

3.1 A brief overview of the parallel foreign-exchange market in Algeria

The parallel market for foreign currencies in Algeria emerged as a result of foreign-exchange restrictions and the difficulty of obtaining foreign currency through official channels, which has led individuals and economic agents to seek alternatives outside the banking system. Although Algeria embarked on reforms and some gradual easing of controls starting in 1994, the parallel market did not disappear; it persisted because demand for foreign currency remained high while official supply was either limited or slow to respond to market needs.

This market is fed by multiple sources of foreign currency, such as transfers and savings from abroad, among others, which makes it active and capable of influencing agents' behavior and expectations. Its development can be viewed in stages: initially associated with goods shortages and tight controls, its role later expanded and became more entrenched, especially after the reform phase, so that the parallel exchange rate has become an important indicator for understanding foreign-exchange pressures in Algeria. This provides a strong motivation for the present research, since the widening gap between the official and parallel rates—and the large volumes traded daily in the main informal market ("le square")—enhance the role of the parallel rate in shaping expectations and decisions. The impact is not confined to the foreign-exchange market; it extends to monetary behavior by prompting agents to hedge and reallocate their portfolios between the dinar and foreign currencies, with direct implications for the M2 money-demand function.

The accurate specification of money demand is therefore even more important for monetary policy in Algeria. Ignoring the influence of the parallel rate may lead to inaccurate estimates of money demand and to a mistaken reading of liquidity conditions. The present study thus seeks to fill an important gap by incorporating the parallel exchange rate among the determinants of money demand in Algeria, thereby improving the explanation of monetary developments and reducing distortions arising from its omission.

3.2 Econometric framework

The study relies on time-series data for the Algerian economy, covering monetary aggregates, economic activity, inflation, and the exchange rate.

Broad money M2 is used as the indicator of money demand, with monthly data obtained from the official website of the Bank of Algeria. This aggregate is more suitable for analyzing saving and hedging behavior and for tracking changes in preferences for holding money balances under economic and monetary fluctuations.

Real gross domestic product (Y) is compiled from the quarterly national-accounts reports of the National Office of Statistics (ONS), in particular bulletins no. 731 (2016) and no. 1054 (2024).

Inflation (INF) is calculated from the overall consumer price index (P), derived from the ONS monthly publications of the consumer-price index (CPI). Inflation is measured as:

$$INF = \Delta \log P_t = \log P_t - \log P_{t-1}$$

The CPI series shows an apparent break in levels around 2002 that does not reflect a genuine change in price levels but is due to a change of base year. Using the raw series would introduce temporal distortions into the analysis, so the series is homogenized by linking the different segments using the overlap period, yielding a consistent, usable series for econometric modeling.
Data for the parallel exchange rate (BEX) are obtained from alternative sources. All time series are converted to quarterly frequency prior to estimation to ensure consistent measurement across variables, by aggregating the monthly series into quarterly values using the arithmetic mean of monthly observations in each quarter.

3.2.1 Stationarity analysis

To test the stationarity of the series used in the model, the study applies the Augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1979; Said and Dickey, 1984) and the Phillips–Perron (PP) test (Phillips and Perron, 1988) at levels and first differences, with a 5 percent significance level.
ADF results indicate that all variables are non-stationary in levels, as the unit-root null cannot be rejected at the chosen significance level. In contrast, PP results suggest that real GDP (RY) and inflation (INF) are stationary in levels, whereas real money demand (RM2) and the parallel exchange rate (BEX) remain non-stationary. Once first differences are taken, both ADF and PP tests show that all variables become stationary, and the unit-root null is rejected at the 5 percent level. The study variables are thus a mix of level-stationary I(0) and first-difference-stationary I(1) processes, with no variable integrated of order two I(2).
Given these stationarity results—namely, the combination of I(0) and I(1) variables and the absence of I(2) series—the ARDL methodology is adopted, as it is well suited for this case and allows testing for a long-run relationship among the variables. This approach follows Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001).

3.2.2 Model selection (Best ARDL model)

To analyze the effect of the parallel exchange rate on broad money demand in Algeria, the following ARDL specification is estimated:

$$\ln M2_t = f(\ln Y_t, INF_t, \ln BEX_t)$$

and, in error-correction form,

$$\Delta \ln M2_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln M2_{t-i} + \sum_{i=0}^{q_1} \alpha_{2i} \Delta \ln Y_{t-i} + \sum_{i=0}^{q_2} \alpha_{3i} \Delta INF_{t-i} + \sum_{i=0}^{q_3} \alpha_{4i} \Delta \ln BEX_{t-i} + \delta_1 \ln M2_{t-1} + \delta_2 \ln Y_{t-1} + \delta_3 INF_{t-1} + \delta_4 \ln BEX_{t-1} + \epsilon_t$$

where M2 is broad money demand, Y is real GDP, INF is inflation (measured as $INF = \Delta \log P_t = \log P_t - \log P_{t-1}$, with P_t the consumer price index), BEX is the parallel exchange rate defined as the number of Algerian dinars per 1 U.S.

dollar, α_0 is the intercept, p is the number of lags of the dependent variable, (q_1, q_2, q_3) are the lag orders of the regressors, α_{ji} are short-run coefficients, and δ_i are long-run coefficients.

The ARDL lag structure is selected using an automatic procedure based on the Akaike Information Criterion (AIC), allowing up to four lags for each variable. The optimal model selected is ARDL(2,0,1,2), which includes $\ln M2$ with two lags, indicating that current real money demand depends significantly on its own past values. Real income $\ln RY$ enters contemporaneously with no lags, suggesting that the effect of economic activity is mainly captured within the same quarter in this model. Inflation (INF) is included with one lag to capture both contemporaneous and lagged effects, while the parallel exchange rate $\ln BEX$ enters with two lags to measure its impact in the current period and over recent quarters. This specification provides the best fit according to the AIC relative to alternative models.

After determining the lag structure, the chosen ARDL model is estimated and the significance of the coefficients examined. The lagged dependent variable $\ln M2_{t-1}$ has a coefficient of 1.11 ($p<0.01$), implying a strong dependence of current broad money demand on its immediate past level, whereas the second lag $\ln M2_{t-2}$ has a coefficient of −0.155 with a p-value close to 5 percent ($p\approx0.051$), indicating partial dynamic adjustment with a second-period lag.

The contemporaneous coefficient on real income $\ln RY$ is 0.037 ($p\approx0.021$), positive and statistically significant, in line with the traditional interpretation that higher economic activity is associated with higher demand for money balances. Inflation exerts a negative and significant effect in the current period (−0.655, $p<0.01$) and with a one-quarter lag (−0.341, $p\approx0.013$), suggesting that inflation reduces money demand both immediately and with some persistence, reflecting the erosion of purchasing power and the higher opportunity cost of holding money.

Regarding the parallel exchange rate, the contemporaneous coefficient on $\ln BEX$ is −0.073 ($p\approx0.048$), indicating a short-run elasticity of money demand with respect to the parallel rate of about −0.073; a 1 percent increase in the parallel rate is associated with a 0.073 percent decline in money demand within the same quarter. The one-quarter lag has a positive coefficient of 0.217 ($p<0.01$), while the two-quarter lag is negative at −0.143 ($p<0.01$). This alternating pattern of signs across lags suggests that shocks to the parallel exchange rate generate a non-monotonic short-run response of money demand, with initial effects that are subsequently offset or reversed before the system converges toward its long-run path, which is assessed later through the long-run coefficients and the error-correction model.

Table 1. Estimated ARDL model

Variable	Coefficient (Estimate)	Std. Error	t-value	p-value	Significance
Intercept	0.08345	0.03338	2.500	0.013657	**
L(lnRM2, 1)	1.11007	0.07901	14.050	<2e-16	***
L(lnRM2, 2)	−0.15501	0.07859	−1.972	0.050696	*
lnRY	0.03740	0.01605	2.330	0.021383	**
INF	−0.65472	0.13486	−4.855	3.42e-06	***

L(INF, 1)	−0.34059	0.13474	−2.528	0.012684	**
lnBEX	−0.07263	0.03636	−1.997	0.047903	**
L(lnBEX, 1)	0.21700	0.05429	3.997	0.000107	***
L(lnBEX, 2)	−0.14339	0.03585	−4.000	0.000106	***

Significance levels: * 1%, ** 5%, * 10%.**[1]

3.2.3 Bounds test for cointegration

The bounds-testing procedure of Pesaran, Shin, and Smith (2001) applied to the selected ARDL model yields an F-statistic of 13.617, with a p-value of 0.000001. This allows rejection of the null hypothesis of no cointegration among the variables. There is thus evidence of a long-run equilibrium relationship between broad money demand (M2) and its determinants, namely real income (RY), inflation (INF), and the parallel exchange rate (BEX), which justifies estimating the associated error-correction model (ECM) to capture short-run dynamics and the speed of adjustment to equilibrium after shocks.

3.2.4 Error-correction model (ECM) results

The ECM estimates indicate that the error-correction term (ECT) carries a coefficient of −0.045, which is highly statistically significant (p<0.01). This confirms the presence of an adjustment mechanism toward the long-run equilibrium after short-run disturbances. The magnitude of this coefficient implies that approximately 4.5 percent of any deviation from equilibrium is corrected each quarter, pointing to a gradual return to the equilibrium path.

Regarding short-run dynamics for the parallel exchange rate, the coefficient on $\Delta \ln BEX$ is −0.073 (p≈0.033), whereas the one-quarter lag $\Delta \ln BEX_{t-1}$ is positive at 0.14 (p<0.01). This pattern reflects a non-instantaneous transmission of shocks from the parallel market to money demand, with an immediate negative response followed by a compensating positive effect in the next quarter. For inflation, the coefficient on ΔINF is −0.65 and strongly significant (p<0.01), indicating that a short-run rise in inflation leads to a clear decline in the growth of real money demand.

The dynamics of the dependent variable are also important: the lagged change in money demand $\Delta \ln M2_{t-1}$ has a positive and significant coefficient of 0.15 (p≈0.038), implying that current changes in money demand depend partly on their own past changes. By contrast, $\Delta \ln RY$ does not appear in the short-run part of the ECM under the selected lag structure, suggesting that the effect of real activity is captured mainly through the long-run equilibrium relationship (via the ECT) rather than through an independent short-run response.

Table 2. Estimated ARDL model

Variable	Coefficient (Estimate)	Std. Error	t-value	p-value	Significance
Intercept	0.08345	0.03338	2.500	0.013657	**
L(lnRM2, 1)	1.11007	0.07901	14.050	<2e-16	***
L(lnRM2, 2)	−0.15501	0.07859	−1.972	0.050696	*
lnRY	0.03740	0.01605	2.330	0.021383	**
INF	−0.65472	0.13486	−4.855	3.42e-06	***
L(INF, 1)	−0.34059	0.13474	−2.528	0.012684	**

lnBEX	−0.07263	0.03636	−1.997	0.047903	**
L(lnBEX, 1)	0.21700	0.05429	3.997	0.000107	***
L(lnBEX, 2)	−0.14339	0.03585	−4.000	0.000106	***

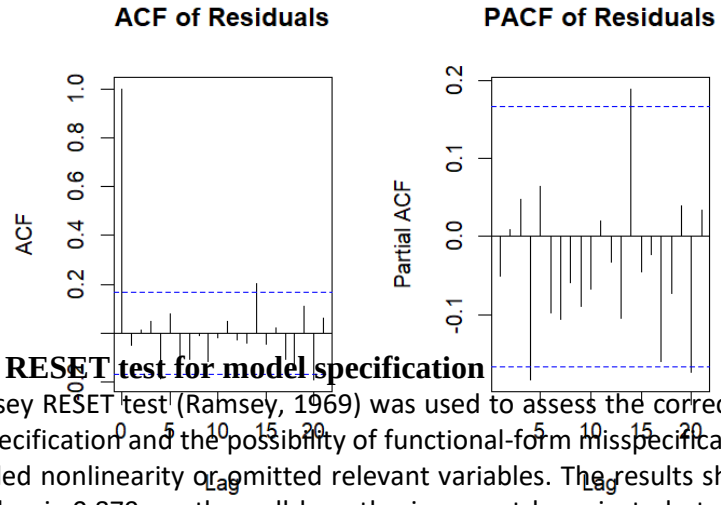
Significance levels: *** 1%, ** 5%, * 10%.[1]

3.2.5 Long-run coefficients

Long-run coefficients derived from the estimated ARDL model shed light on the equilibrium relationship between broad money demand (M2) and its determinants. The long-run coefficient on real income $\ln RY$ is positive and highly significant at the 1 percent level (0.832, p<0.01), implying that a 1 percent increase in real output is associated with about a 0.83 percent increase in real M2 in the long run, consistent with conventional money-demand theory.

Inflation (INF) exerts a negative and statistically significant long-run effect, with a coefficient of −22.1497 (p<0.01), indicating that higher inflation reduces real money demand in the long run through higher opportunity costs and erosion of purchasing power. By contrast, the parallel exchange rate $\ln BEX$ has a small and statistically insignificant long-run coefficient (0.0218, p=0.899), suggesting that its influence does not materialize as a persistent equilibrium determinant of M2 under the estimated specification. Instead, its role appears to be concentrated in short-run dynamics.

Figure (01): Autocorrelation plots of the model residuals (ACF/PACF)



Ramsey RESET test for model specification

The Ramsey RESET test (Ramsey, 1969) was used to assess the correctness of the model specification and the possibility of functional-form misspecification, such as unmodelled nonlinearity or omitted relevant variables. The results show that the test p-value is 0.879, so the null hypothesis cannot be rejected at conventional significance levels. This indicates that there is no statistical evidence of misspecification in the functional form of the estimated ARDL model, which supports the adequacy of the specification adopted in the study.

3.2.7 Interpretation of long-run results

The long-run coefficients were derived from the selected ARDL model in order to identify the long-run equilibrium relationship between broad money demand (M2) and its determinants. The results first show that the long-run coefficient on real income lnRY is positive and statistically significant at the 1% level (0.832, p<0.01),

which means that higher economic activity is associated with higher real money demand in the long run; specifically, a 1% increase in real output is accompanied by an increase of about 0.83% in real M2, consistent with the traditional interpretation of the money-demand function.

Second, inflation (INF) has a negative and statistically significant effect (−22.15, $p<0.01$), indicating that higher inflation leads to a decline in real money demand in the long run, which can be explained by the higher cost of holding money balances and the erosion of their purchasing power. Finally, the parallel exchange rate lnBEX does not exhibit a significant long-run effect (0.022, $p=0.899$), suggesting that, in this model, its influence does not materialize as a persistent equilibrium determinant of money demand; instead, its main role is likely to lie in short-run dynamics associated with shocks and expectations in the parallel foreign-exchange market.

Table 3. Long-run coefficients

Variable	Coefficient (Estimate)	Std. Error	t-value	p-value	Significance
Intercept	1.8572	0.9721	1.9104	0.0583	*
lnRY	0.8322	0.1565	5.3163	0.0000	***
INF	−22.1497	7.8253	−2.8305	0.0054	***
lnBEX	0.0218	0.1721	0.1269	0.8992	—

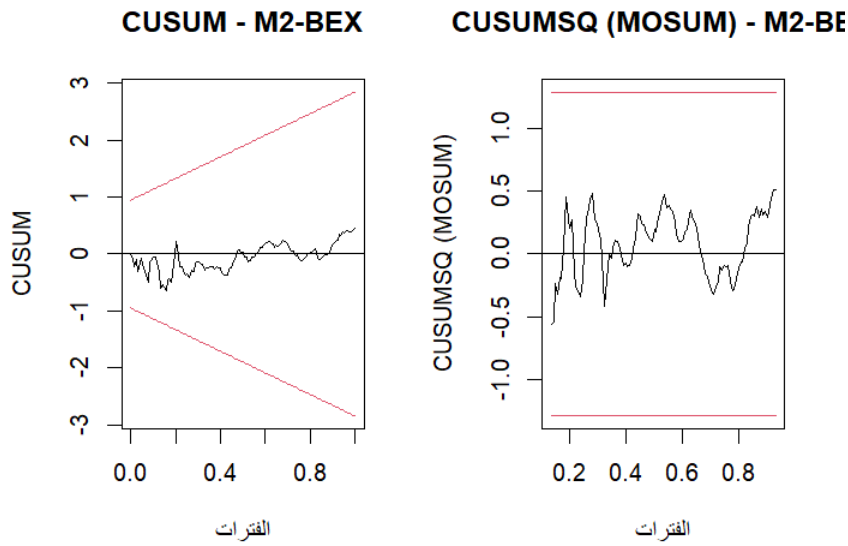
Significance levels: *** 1%, ** 5%, * 10%; "—" = not significant

3.2.8 Stability tests for model coefficients (CUSUM and MOSUM as an alternative to CUSUMSQ)

The structural stability of the estimated ARDL model coefficients was examined using the CUSUM (Recursive CUSUM) test (Brown, Durbin, & Evans, 1975) and the MOSUM (Recursive MOSUM) test (Chu, Hornik, & Kuan, 1995) as a complementary stability check, with MOSUM used here as a practical alternative to the CUSUMSQ test within the strucchange framework. The CUSUM test produced a p-value of 0.6487, while the MOSUM test yielded a p-value of 0.5883, so the null hypothesis cannot be rejected at conventional significance levels. The corresponding plots show that both test statistics remain within the critical bounds over the full sample period without systematic boundary crossings, indicating that the model coefficients are stable over time and that there is no statistical evidence of structural breaks that would materially affect the estimated relationship during the study period.

Taken together, the CUSUM and MOSUM stability tests provide reassurance that the model parameters are stable. In conjunction with the evidence of cointegration from the bounds test and the significance of the error-correction term in the ECM, it becomes appropriate to discuss the results along two dimensions: how money demand responds to shocks in the short run and what its equilibrium determinants are in the long run.

Figure (02) CUSUM and CUSUMSQ Tests



3.3 Discussion of results

The ARDL results confirm the existence of a long-run equilibrium relationship between broad money demand and its key determinants, as indicated by the bounds test F-statistic and the negative, significant error-correction term in the ECM. Together with the structural-stability tests (CUSUM and MOSUM), which do not reveal any significant parameter instability, this supports interpreting the estimates within a stable, well-specified framework.

3.3.1 Short-run dynamics and speed of adjustment

The estimated ECT coefficient of about −0.0449 indicates that only around 4.5 percent of any disequilibrium is corrected each quarter, implying a relatively slow pace of adjustment toward the long-run money-demand equilibrium. This is consistent with features of the Algerian economy, where monetary and behavioral adjustments—such as portfolio reallocation, saving habits, and real-sector responses—tend to exhibit inertia, and where institutional and regulatory factors may cause the effects of shocks (particularly in prices and foreign exchange) to feed through gradually to money-holding behavior.

In the short run, inflation has a strong and immediate negative impact on real money growth: the significantly negative coefficient on ΔINF suggests that higher inflation quickly weakens the incentive to hold domestic money balances, as agents react to the "inflation tax" on money and adjust their portfolios accordingly. For the parallel exchange rate, the ECM reveals a clear short-run impact on money demand: the negative coefficient on $\Delta \ln BEX$ indicates that a depreciation in the parallel market is associated with a fall in real money growth, reflecting precautionary behavior and declining confidence in the domestic currency.

The subsequent positive lagged effect of $\Delta \ln BEX_{t-1}$, followed again by a negative lag at longer horizons in the ARDL levels equation, suggests that the response of money demand unfolds over time rather than in a single step. After the initial shock

in the parallel market, part of the domestic liquidity may return for transaction purposes or as agents reassess whether the shock is temporary, before renewed pressures emerge if instability in the parallel market persists or negative expectations become entrenched. The positive and significant lagged change in $\ln M2$ confirms that adjustment is gradual and path-dependent.

The results also show that the impact of the parallel market is not uniform across monetary aggregates: the parallel-rate coefficients were not significant when M1 was used, but became significant when M2 was the dependent variable, suggesting that exchange-rate volatility affects mainly saving and hedging components of money rather than narrow transaction balances.

3.3.2 Long-run determinants and equilibrium relationship

Given that the bounds test rejects the null of no cointegration, the long-run coefficients can be interpreted as defining an equilibrium money-demand relationship. The positive, less-than-unit income elasticity (around 0.83) is in line with standard theory and with empirical evidence for many developing economies, indicating that real money demand grows broadly in proportion to real activity, but slightly less than one-to-one.

The large negative long-run coefficient on inflation confirms that persistent inflationary pressures undermine real money demand, reinforcing the view of inflation as a key “tax” on money holdings. By contrast, the insignificant long-run coefficient on the parallel exchange rate suggests that its primary role is to generate short-run portfolio shifts and liquidity adjustments rather than to anchor the long-run level of broad money demand. In policy terms, this implies that while monetary authorities must closely monitor the parallel market because of its short-run impact on liquidity and confidence, long-run money-demand stability is more strongly driven by real activity and price stability.

3.3.3 Interpreting the effect of the parallel exchange rate on money demand

On the basis of the empirical results, fluctuations in the parallel exchange rate clearly affect money demand in the short run, as evidenced by the contemporaneous negative impact of changes in BEX and the associated lagged dynamic responses. This pattern reflects the sensitivity of economic agents to shocks and expectations in the parallel foreign-exchange market, where rising uncertainty prompts a rapid adjustment in money-holding behavior.

However, the absence of a statistically significant long-run effect of the parallel exchange rate indicates that, within the adopted specification, this variable does not become a permanent equilibrium determinant of the level of money demand; instead, the long-run relationship is mainly governed by more stable macroeconomic factors such as real activity and the price level. From a policy perspective, these findings suggest that anchoring expectations and keeping inflation under control are the two key pillars for supporting long-run stability of money demand, while recognizing that volatility in the parallel market remains influential for monetary behavior in the short run.

Finally, it is worth noting that the adequacy of the model specification is supported by the RESET test, which provides no evidence of functional-form misspecification, and by the short-run autocorrelation tests (Breusch–Godfrey and Durbin–Watson),

which do not indicate any serious problem. Taken together, these elements support the econometric robustness of the main results.

Conclusion :

This study set out to analyze the impact of fluctuations in the parallel exchange rate on broad money demand (M2) in Algeria and to characterize the nature of this impact in both the short and long run. It employed the ARDL methodology, which is well suited to situations where variables exhibit mixed orders of integration between I(0) and I(1), and the automatic lag-selection procedure based on the AIC criterion yielded an ARDL(2,0,1,2) specification.

The bounds test confirmed the existence of cointegration among the variables, indicating a long-run equilibrium relationship between money demand and its determinants. The error-correction model (ECM) showed that the error-correction term is negative and statistically significant, signaling the presence of an adjustment mechanism back to equilibrium following short-run shocks, although the speed of adjustment is gradual, reflecting a relatively slow correction process. Structural-stability tests (CUSUM and MOSUM) did not reveal any statistical evidence of parameter instability over the sample period, and the diagnostic tests supported the correctness of the model's functional form.

In the short run, the results indicate that inflation has a strong negative effect on changes in real money demand, reflecting the higher cost of holding money balances and the erosion of purchasing power. The parallel exchange rate also exerts a short-run influence: an immediate negative response is followed by a positive lagged effect. This pattern suggests that shocks in the parallel market quickly affect money-holding behavior through expectations and heightened uncertainty, before behavior gradually adjusts. In the long run, the estimated multipliers show that real output is a positive and significant determinant of money demand, whereas inflation has a negative and significant effect. By contrast, the parallel exchange rate does not display a significant long-run effect in the estimated specification, which implies that its influence appears more like a short-run transmission channel than a permanent equilibrium determinant of broad money demand.

Taken together, the findings suggest that parallel-market volatility is associated with short-run responses in money-demand behavior when shocks to the parallel exchange rate occur, but that this effect does not translate into a stable long-run relationship for the level of money demand within the adopted model. Implicitly, long-run stability of money demand depends primarily on controlling inflation and anchoring expectations, while recognizing that parallel-market fluctuations remain important in the short run through hedging and precautionary-behavior channels.

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