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IMPACT OF UNCONVENTIONAL FINANCING ON ECONOMIC GROWTH AND INFLATION IN ALGERIA

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Abstract:

The objective of this study is to investigate the impact of unconventional monetary policy on inflation and economic growth in Algeria. To investigate this impact, we estimated a SVAR model, covering the period from 2006 to 2022 using quarterly data. The originality of this study is the use of the estimated dynamic effects of shocks (stylized facts) as a benchmark for assessing the effectiveness and pass-through of unconventional policies. Our results show that the shock induced by unconventional monetary policy is not transmitted to inflation, neither in the short run nor in the long run, even under theoretical restrictions. In addition, unconventional monetary shocks have no effect on real variables (economic growth).

Key words: SVAR, unconventional monetary policy, impulse responses, short-run and long-run restrictions.

JEL Classification Codes : E510, E520, C320.

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Introduction:

In order to achieve their objective of price stability, central banks have one main instrument: setting the policy interest rate. The level and variations in the key interest rate influence the economy mainly through the interest rate and credit channels. However, traditional monetary policy instruments can become ineffective in some crisis situations. Central banks are then led to adopt measures described as "unconventional". Unconventional measures are temporary monetary policy actions designed to re-establish the transmission channels of monetary policy and ultimately providing support to bank credit and liquidity in the money market. In Algeria, unconventional monetary policy, often referred to as "unconventional financing", is motivated by the needs related to the budget deficit and to provide support to banking liquidity. The movements of the liquidity in the money market in resource-rich countries deserve particular attention.

The surplus of foreign currency resources in oil-exporting countries leads to an excess of liquidity that prevents the monetary policy transmissions. This situation is described as a "financial curse" (Beck, 2011). Banks don't need refinancing from the central bank, but instead they seek to obtain a relatively high risk-free return from securities issued for sterilization purposes. Therefore, this situation invalidates the conventional monetary policy instruments. In this regard, following the emergence of the phenomenon of excess liquidity in the Algerian banking system from 2002 onwards, banks did not need refinancing from the Bank of Algeria over a long period. Moreover, the Bank of Algeria ceased to manipulate the key interest rate, leaving it fixed at 4% from 2004 to 2015. However, in the event of a fall in resources, the money destroyed by the deterioration of the external balance is one of the main causes of liquidity stress.

Indeed, the turnaround that occurred following the drop in oil prices in June 2014 led to the onset of banking liquidity stress. To address this situation, the Bank of Algeria reactivated the discount window in August 2016. In parallel, six (06) months after the relaunch of the discount window, the banking system witnessed the establishment of Open Market operations, introduced as a substitute for discount operations. Despite these efforts, the severity of the crisis led the authorities to revise, in October 2017, the

legal framework governing financial relationship between the Treasury and the Bank of Algeria. This revision establishes the fiscal dominance known as "unconventional financing": the Treasury will directly seek assistance from the Bank of Algeria to cover the financing needs of the budgetary deficit. In this new reconfiguration, **the general problematic of this study is to know what would be the impact of this new financing mechanism on the Algerian economy. Also, it would be important to investigate the impact of this new financing mechanism on the inflation and economic growth in particular**.

The experience of some developing countries has shown that fiscal dominance, characterized by the sustained monetization of budget deficits, leads to a situation where claims on the State represent the largest part of the central bank's domestic assets, which exceed its external assets. Claims held on the government become the main source of monetary base creation (central bank money). Thus, it is the financing needs of the state that determine the issuance of the monetary base by the central bank. In this case, to assess the effects of the so-called unconventional measures implemented by some developing countries such as Algeria, the monetary base aggregate is the most relevant to analyze. On the other hand, in evaluating the effects of unconventional measures such as "Quantitative Easing," it would be appropriate to examine the broad money aggregate.

The transmission of unconventional financing can be analyzed following the money multiplier principle (Bowdler and Radia, 2012). According to the multiplier principle, **the general hypothesis of this study is that a change in the monetary base should result in a change in the money supply**. This demonstrates how unconventional financing could be risky, if the transmission to the money supply will be effective. **In this sense, as partial hypothesis we can say that an increase in the money supply can lead to an increase in the inflation**. Indeed, the Bank of Algeria considers the money supply M2 (excluding deposits from the hydrocarbon sector) to be the main determinant of inflation over the period 2001-2014. It contributes to 70.7% of overall inflation (Bank of Algeria, 2014).

To examine the impact of unconventional financing through this money multiplier principle, **we have applied a Structural Vector Autoregressive (SVAR) methodology**

for the Algerian economy, covering the period 2006 to 2022. **The SVAR methodology** can be used to establish some relevant stylized facts. Furthermore, **the importance of this study is** that the restrictions of our model are based on the quantity theory of money. Mainly, nominal shocks have no long-run effect on real variables. In addition, **the objective of this study** is to use the estimated dynamic effects of shocks as a reference to learn more about the effectiveness and pass-through of unconventional policies on growth and inflation. The rest of the work will be as follows. Section two (2) will be devoted to the literature review. Section three (3) will describe the methodology used. Sections (4) and (5) will present the results and discussions. Section (6) concludes.

2. Literature review:

At present, there is an abundant literature dealing with the consequences of unconventional monetary policies. Central banks are compelled to implement measures described as "unconventional" in order to restore the effectiveness of monetary policy transmission channels that are no longer functioning satisfactorily. Many central banks widely adopted unconventional monetary policies during the 2008 financial crisis. Since then, several descriptive (Borio and Disyatat (2009)), theoretical (Adrian and Song Shin (2009), Gertler and Karadi (2011)), and empirical (Beaupain et Durré, 2016) studies have contributed to a better understanding of these unconventional monetary policies.

Regarding the theoretical underpinnings of unconventional monetary policy, there are studies that emphasize the role they played even before the 2008 financial crisis. Indeed, Bernanke and al. (2004) discuss the most important unconventional monetary measures, as well as the way in which a central bank can combine conventional and unconventional instruments. Furthermore, their analysis highlights three unconventional policies that a central bank could use when the monetary interest rate reaches its limit, namely: (1) commitment to the future trajectory of interest rates (forward guidance); (2) quantitative easing; (3) adjusting the structure of the central bank's balance sheet through, for example, the targeted purchases of long-run bonds in order to reduce the long-term interest rate.

The contribution of descriptive studies accelerated after the financial crisis. Comparing conventional and unconventional monetary measures, Borio and Disyatat (2009) identify the first category as interest rate policy, while the second category is termed balance sheet policy. Furthermore, Borio and Disyatat (2009) consider credit easing measures and quantitative easing measures to be the two categories of unconventional monetary policies. However, among unconventional monetary policies, quantitative easing is the most extensively employed measure, which was adopted on a large scale in Japan after the 1990s crisis and in the United States and the Eurozone after the 2008 financial crisis.

Basically, quantitative easing involves the acquisition of long-term financial assets in exchange for the liquidity injections that central banks make, all aimed at boosting economic growth. It is important to note that quantitative easing is a method that was already used in monetary practice before the 2008 financial crisis, but its implementation after 2008 focused not only on government bonds, but also on private (corporate) bonds and other types of private assets. On the other hand, the credit easing widely used by the European Central Bank and Forward Guidance are strictly unconventional monetary measures designed to prevent the collapse of the banking system.

The widespread use of this new financing method has prompted researchers to empirically assess its transmission mechanism and its impact on the economy, particularly inflation and growth. Baumeister and Benati (2012), for example, examined the impact of unconventional monetary policy in the United States, England and Japan, using a Structural Vector Autoregressive (SVAR) model based on a Bayesian approach. The study concludes that quantitative easing had a significant effect on economic growth and inflation in all countries studied. In addition, their study mentions that unconventional monetary policy measures implemented by the US Federal Reserve (Fed) and the Bank of England succeeded in preventing significant risks of deflation and economic collapse, similar to those observed during the Great Depression of 1929.

Using a Structural Vector Autoregressive model (SVAR), Peersman (2011) investigated the unconventional measures adopted by the European Central Bank, and

argues that unconventional monetary policy shocks beyond the policy rate, through increases in the size of the balance sheet or the monetary base, have a significant impact on economic activity and inflation. However, the transmission mechanism turns out to be different compared to traditional interest rate innovations. Similarly, Gambacorta and al. (2014), by estimating a panel vector autoregressive (PVAR) model with monthly data from eight advanced economies, conclude that Eurozone GDP increased from 1.3% to 3.2% following a 3% increase in the size of the ECB's balance sheet. However, the estimated effects on the price level, relative to conventional monetary policy, are weaker and less persistent.

With regard to Forward Guidance, which is also an unconventional monetary instrument, the impact of macroeconomic and financial policy announcements during the 2008 crisis in the United States, the United Kingdom, the euro zone and Japan was associated with a reduction in interbank risk premia, especially for recapitalization programs (Aït-Sahalia and al., 2012). In parallel, some studies show that the special long-term refinancing operations announced by the European Central Bank had the effect of reducing the market risk premia. The credibility of the European Central Bank's announcements has significantly improved banking financing conditions in the Eurozone. This credibility was materialized by the regular provisioning of the interbank market, overcoming the liquidity constraint faced by financial institutions.

Regarding the Algerian economy, Kerzabi and al. (2020) examined the effect of unconventional financing on inflation in Algeria over the period 1990 - 2018, using the VECM model (using dummy variables to characterize unconventional financing) to show that the money supply and unconventional financing do not explain price trends in Algeria. Furthermore, using a theoretical approach, Khelifi (2021) concludes that unconventional financing has positive effects in the short term, by filling the treasury's financing requirement. However, this mode of financing generates harmful consequences in the medium and long term, essentially through the emergence of inflationary pressures. Similarly, Zourdani (2019), based on a mixture of literature on the issue of unconventional financing, estimates that the significant liquidity generated by

unconventional financing will certainly have adverse consequences on inflation. This observation is also shared by Gharbi and Ayachi (2021), who argue that increasing the money supply without a counterpart in production will create an imbalance, leading to inflation that could even reach four figures."

Benzegane (2023) also believes that there are objective arguments in favor of resorting to external debt instead of unconventional financing. Her analysis mentions that this could enable Algeria to finance solid, sustainable economic growth. She explains that the consequences of applying unconventional financing in Algeria lie in the impact on the behavior of economic agents. Benzegane (2023) believes that Algerians people are rational agents and know that this unconventional monetary policy will have two main consequences: inflation and the weakening of the Bank of Algeria. The first consequence, inflation, will cause the value of the dinar to fall, raising the price of imported goods and accentuating the loss of purchasing power for consumers and producers. The second consequence will have a negative impact on economic agents' confidence in the Bank of Algeria. The researcher supports her analysis with the observation that many Algerians are running away from the national currency, reducing their dinar holdings and preferring to buy foreign currency on the parallel market or real estate, which are considered to be safe havens.

Regarding other economic impacts, Merouani and Zourdani (2022) confirm, relying on principal component analysis, that unconventional financing had no effect on the real economy. In their view, unconventional financing only partially filled the budget deficit. It is worth noting that some studies highlight that the immediate impact of this unconventional financing is the transition of the banking system from a liquidity crunch to a liquidity surplus, prompting the Bank of Algeria to adapt its monetary policy instruments (Aoudia (2022)). In addition, Zidelkhil and Mouhoubi (2020) had shown, based on econometrics, that unconventional financing made it possible, at least in the short term, to make the intertemporal budgetary constraint of the State viable and to continue the social character public spending. Indeed, their calculation of the Social Expenditure Index "SDI" from 1982 to 2019" showed that the index has remained without

significant variation since the oil shock of 2014. However, Belkacemi and Amnache (2022) consider that the evaluation of unconventional financing in Algeria would be biased because it was only adopted over two years instead of five years as provided for in the regulatory text. Also, other factors combined with the oil crisis, such as the citizen revolution of 2019 and the Covid-19 pandemic which hit the economy from other angles.

However, all of these studies do not provide a definitive answer on the impact of unconventional financing in Algeria. Indeed, one of the most suitable tools for this kind of assessment is the SVAR model. Economic policy analysis widely uses SVAR model (Policy Analysis and Advice), as it quantifies knowledge of the relationships between macroeconomic variables. For example, what happens to prices and output in the event of a demand shock? It is from this perspective that we built our model, **with the aim of providing solid explanations on the impact of unconventional financing (pass-through of this new instrument) on the Algerian economy.** Let us now move on to a more detailed description of this methodology.

3. Methodology:

3.1 data:

The data used during our work come from the statistical bulletins of the Bank of Algeria for the money mass and monetary base variables, and from the publications of the Office of National Statistics for the consumer price index and economic growth. Our sample covers the period from June 2006 to September 2022, on a quarterly basis. Our sample is relatively representative, insofar as it covers the period of excess liquidity, liquidity crunch and the implementation of unconventional financing.

The first monetary variable used is the Monetary Base. It represents the Bank of Algeria's liabilities as the main counterpart to its total assets. These liabilities are made up of currency in circulation and deposits held in reserves by banks at the Bank of Algeria. The second variable is the money supply (M2). The money supply expands beyond the monetary base to include other assets that may be less liquid in form. It is the basic aggregate of the monetary situation. According to the Bank of Algeria, it includes

fiat currency in circulation outside banks, sight deposits, passbook deposits and term deposits in national currency or foreign currencies held by non-financial agents with banks, Postal Current Accounts and the Treasury.

For macroeconomic variables, we have introduced into our model the consumer price index (CPI) and the growth rate of GDP, produced by the Office of National Statistics (ONS). The Consumer Price Index (CPI) measures change over time in the prices paid by consumers for a representative basket of goods and services. It enables us to measure the general trend in the prices of the goods and services we consume. The base year for this index is 2000, and the reference year (100 for calculation purposes) is 2001. According to the ONS, the national index is compiled by observing prices in a sample of 17 towns and villages representative of the national territory and distributed according to the geographical strata of the consumer expenditure survey.

The fourth variable used in our analysis is the year-on-year chained volume GDP growth rate. It is based on the conceptual framework defined by the System of National Accounts, which complies with United Nations standards (SNA 1993). Changes over time are adjusted for price variations. Data are also adjusted for seasonal variations. The disadvantage of this indicator, compared to our model, is that it is calculated in relation to the same quarter of the previous year. It would be very useful if the ONS produced an index reflecting quarterly growth.

3.2 Reference VAR model for the Algerian economy:

The basic VAR model that will be used to decompose innovations in unconventional monetary shocks is as follows:

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-pt} + \varepsilon_t . \qquad (3.1)$$

Where y_t is a vector of endogenous variables containing the natural logarithms in first differences of the monetary base (dlbase_m), the money supply (dlmasse_m), the consumer price index (DLIPC) and the growth rate of GDP(PIB_TRIM).

To transform reduced-form VAR errors into uncorrelated structural shocks, additional identification restrictions are used. Structural vector autoregressions (SVARS)

specify restrictions that, in general, are motivated by economic theory. Four common sets of restrictions are used to identify SVARS: short-run restrictions, long-run restrictions, a combination of both and sign restrictions. In its most general representation, a SVAR model can be written as follows:

$$Ay_t = A_1^s y_{t-1} + ... + A_p^s y_{t-p} + B\mu_t \qquad (3.2)$$

Where y_t is a (N ×1) vector of endogenous variables, A_i^s is an (N ×N) matrix containing the parameters on the ith lag, with A representing the contemporaneous interactions between the variables A. and all A_i^s are the structural coefficients, and the μ_t are the unobserved orthonormal structural innovations, with $E(\mu_t \mu_t^{'}) = I_k$. In macroeconomic applications of SVAR, structural shocks, μ_t, may consist of, for example, monetary or fiscal policy shocks, goods market shocks resulting from either aggregate demand or supply, nominal shocks and asset market shocks. It is the fact that the covariances of μ_t are all zero which gives μ_t its structural interpretation, since each shock is, by definition, unique.

It is easy to see the relationship between the SVAR specification and the corresponding VAR in reduced form. Assuming A is invertible, we have:

$$y_t = A^{-1}A_1^s y_{t-1} + ... + A^{-1}A_p^s y_{t-p} + A^{-1}B\mu_t$$

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + \varepsilon_t \qquad (3.3)$$

So, the delay matrices of the reduced form are $A_i = A^{-1}A_i^s$ and the error structure of the reduced form is given by:

$$\varepsilon_t = A^{-1}B\mu_t = S\mu_t$$

With $\mathrm{E}(\varepsilon_t \varepsilon_t') = \sum_{\varepsilon} = A^{-1}BBA^{-1} = SS'$ (3.4)

Where $A^{-1}B = S$

SVAR estimation uses the variance-covariance matrix $\sum_{\varepsilon}$ of errors obtained from the reduced-form VAR. The challenge of SVAR estimation is that there are only $K(K+1)/2$ moments in the variance-covariance matrix $\sum_{\varepsilon}$ and more than $K(K+1)/2$ elements in A and B, or in S, so these matrices are not identified unless additional restrictions are provided. Prior knowledge and theory often suggest restrictions on structural matrices, allowing you to identify and estimate SVAR parameters (Rubio et.al 2010). In our analysis, we will specify short- and long-run restrictions. Note that short-run restrictions can be done in two different ways.

3.2.1 short run Restrictions on A et B matrices:

The first method of identifying shocks in SVAR models is based on short-run restrictions. It is obtained formally by imposing zero restrictions on the matrix A in (3.2) since it represents the contemporaneous relations between the y_t variables.

From equation (3.4), we can write the short-run model A B in the form:

$$\varepsilon_t = A^{-1}B\mu_t$$

$$A\varepsilon_t = B\mu_t \qquad (3.5)$$

$$\sum_{\varepsilon} = A^{-1}BBA^{-1\prime}$$

We can use the estimated moments $\sum_{\varepsilon}$ as well as the $K(K+1)/2$ equations of unique covariance in equation (3.4) to estimate the $2K^2$ elements in A and B. Satisfying the order condition requires additional restrictions of $2K^2 - K(K+1)/2 = K^2 + K(K-1)/2$ for identification. Restrictions on A and B take the form of assumptions on the contemporaneous feedback structure of variables in the SVAR and assumptions on the correlation structure of errors, respectively. The second method of short-run restrictions is the restrictions on the matrix S.

It should be noted that restrictions on A control the contemporaneous relationships between variables y_t, while restrictions on S control the relationships between variables y_t and structural shocks. Both methods are commonly adopted in SVAR models. If A is triangular, then A^{-1} and S are both triangular, hence the equivalence of the two methods for imposing short-run restrictions. This is not the case for non-recursive models.

3.2.2 Restrictions on F (long-run):

The other approach to imposing restrictions is to constrain long-run impulse responses: having values motivated by economic theory. We can write these long-run restrictions as:

$$(I - A_1 - A_2 - ... - A_p)^{-1}\varepsilon_t = \psi\varepsilon_t = F\mu_t$$

Where:

$$\sum_{\varepsilon} = \psi^{-1}FF'\psi^{-1'} \qquad (3.6)$$

With $\psi = (I - A_1 - A_2 - ... - A_p)^{-1}$ is the long-run multiplier, which can be estimated using the parameters in the reduced form VAR. Note that the long-run model F is linked to the S model through $F = \psi S$ and that, as in the S model, order condition requires K^2 - K(K+1)/2 = K(K-1)/2 additional restrictions.

Long-run restrictions are specified based on the elements of the matrix F, typically in the form of zero restrictions. The restriction $F_{i,j} = 0$ means that the (cumulative) response of the i^{th} variable to the j^{th} structural shock is zero in the long term.

4. Results:

Sims' (1980) model of the US economy is considered the first SVAR model that imposes a recursive structure on short-run parameters. Since then, several researchers have introduced different ways of imposing restrictions following the evolution of economic theory. In our model, we first impose that monetary shocks (conventional or

unconventional) do not have contemporaneous effects on output (Peersman, 2005). This is explained by the fact that a positive effect on the money supply, for example, takes time to be transmitted to the real economy. Before proceeding with the estimation of impulse responses, let's review the preliminary steps for model validation. First of all, the results of the stationarity tests are summarized in the following table:

Table 1: Results of stationarity tests:

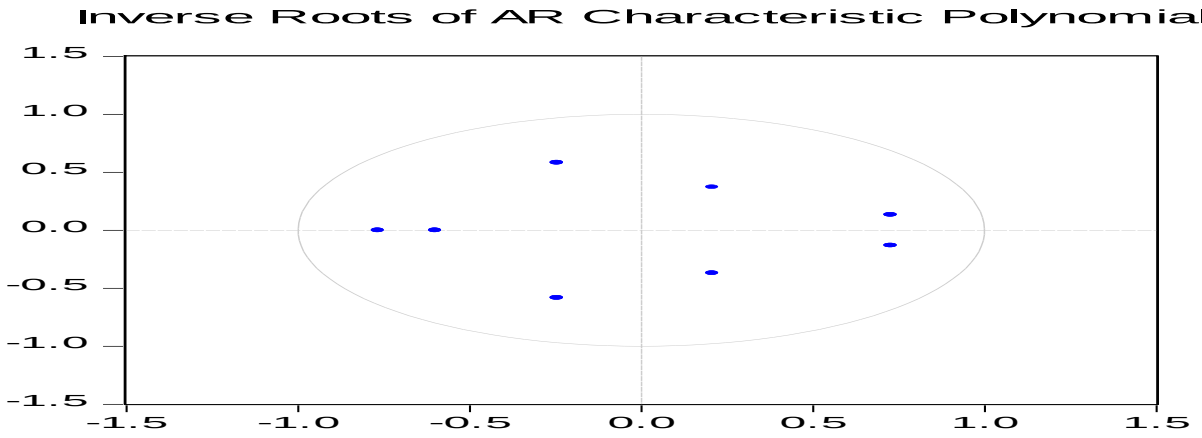
Variables	Nature	Level	ADF-statistics	Tabulated statistics	Results	Order of integration
Monetary base	In level	5%	-1.92	-3.48	Non-stationary	I(1)
	In first difference		-11.70	-3.48	Stationary	
Money supply (M2)	In level	5%	-3.00	-3.47	Non-stationary	I(1)
	In first difference		-3.58	-2.90	Stationary	
CPI	In level	5%	-3.08	-3.48	Non-stationary	I(1)
	In first difference		-3.33	-2.90	Stationary	
GDP growth	In level	5%	-3.98	-2.90	Stationary	I(0)

Source: Prepared by the two researchers based on Eviews.

We observe that except for GDP growth, all other variables are non-stationary in level. However, a single differentiation was sufficient to make the series stationary. Following the classic procedures for choosing lags that stabilize the VAR model in its reduced-form and make the errors stationary, we chose a VAR with 2 lags[†].

[†] See appendices for detailed steps leading to model validation

Figure 1: stability of the VAR model**:**



Source: Prepared by the two researchers based on Eviews.

The inverse of the 8 roots associated with the AR part belongs to the complex unit circle. Our VAR model in its reduced form is therefore stationary. This stability is important to enable the model to return to equilibrium in the event of exogenous shocks. Now, let's move on to diagnosing the model's residuals.

Table 2: Model Residuals Diagnosis**:**

TESTS	Null hypothesis	P-Value	Results
LM (Lagrange Multiplier) test for autocorrelation of residuals (up to 3 lags)	No autocorrelation of errors	0.55	The null hypothesis cannot be rejected. This means that, at the 5% level, there is no autocorrelation of the errors.
The chi-square test for heteroskedasticity of residuals	Homoscedasticity of errors	0.69	The null hypothesis cannot be rejected, which implies that at the 5% level the residuals are homoscedastic.

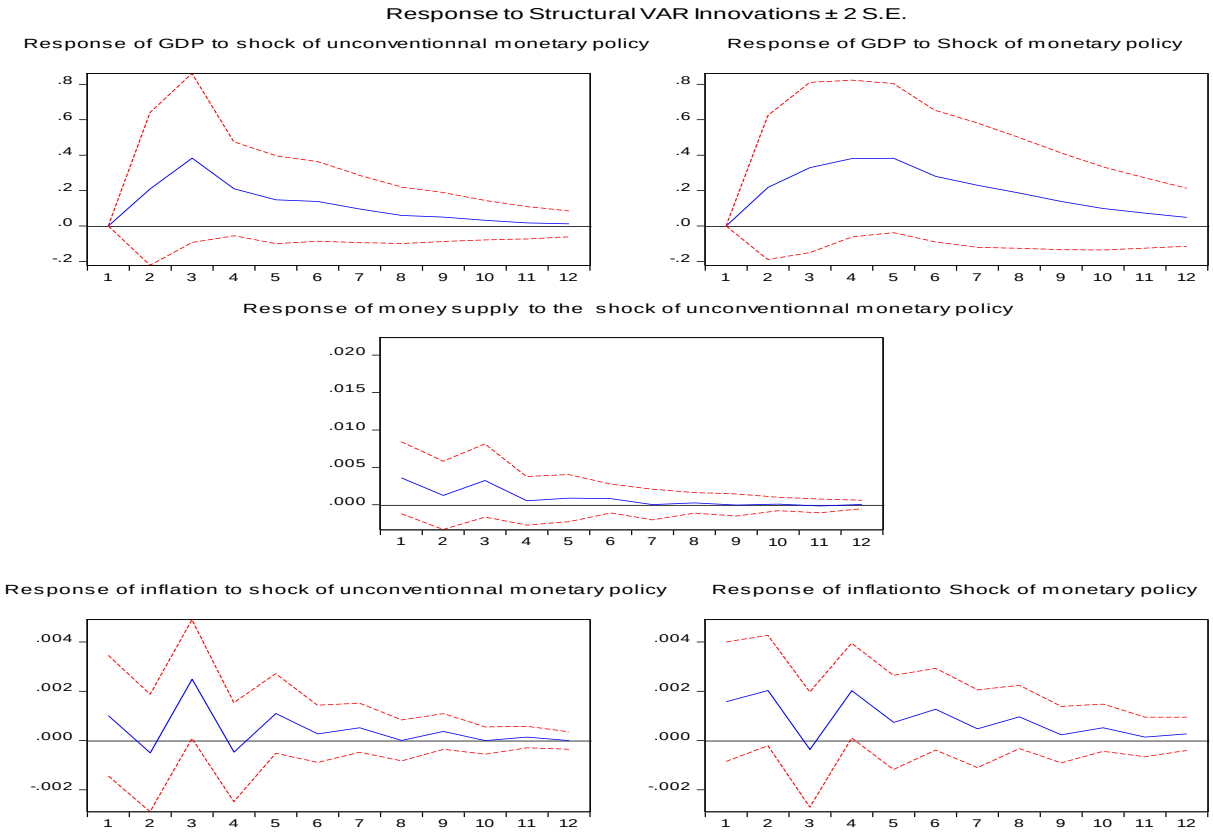
Source: Prepared by the two researchers based on Eviews.

Our model is now validated. Indeed, the tests confirm the absence of autocorrelation of the errors, with the variance of the residuals not varying according to the levels of the independent variables. The impulse responses of an unconventional monetary shock are shown on the following figure (see figure 2).

The results reflect the structure of the Algerian economy: market mechanisms take time to become established. The predominance of the welfare state and the non-diversification of the economy distort some economic realities: subsidies, the dominance

of state-owned banks and heavy dependence on volatile hydrocarbon prices. The above results show that the unconventional monetary shock is transmitted less than proportionally to the money supply over the short and the long run. Moreover, this transmission is not significant (the confidence interval contains zero). Similarly, transmission to inflation is very negligible, and also insignificant. Furthermore, it is important to note that our results highlight that the unconventional monetary shock in Algeria is weakly transmitted to the real economy.

Figure 2: Impulse responses to an unconventional monetary shock (short-run restrictions).



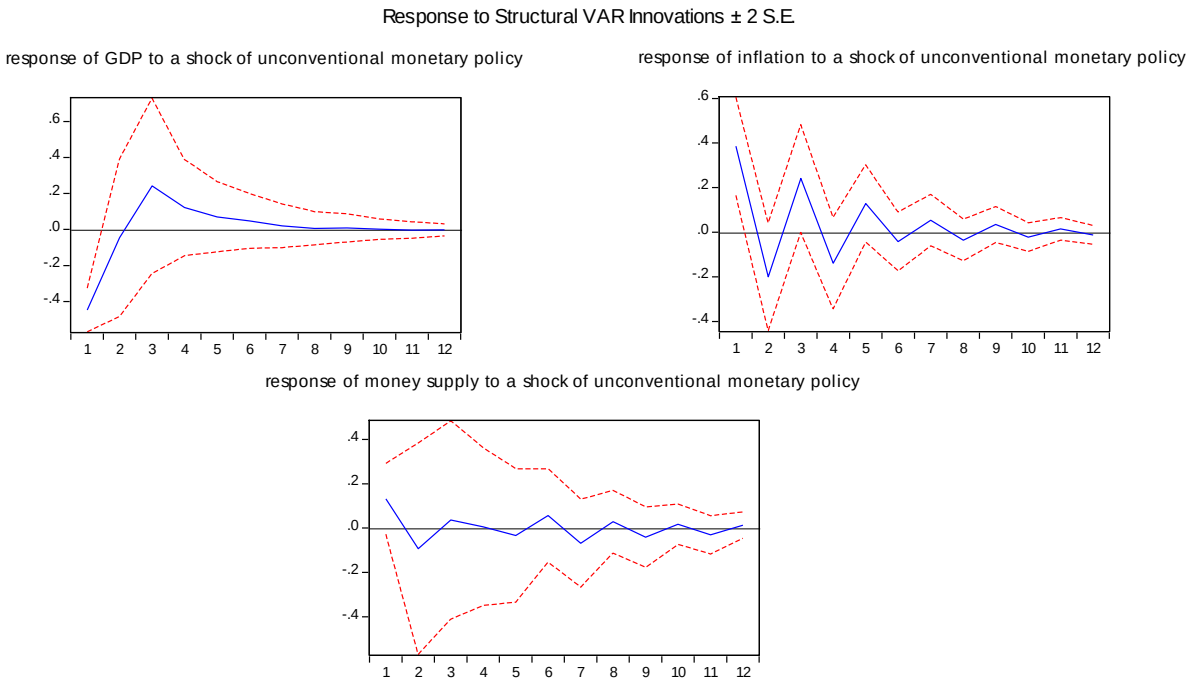
Source: Prepared by the two researchers based on Eviews.

In fact, these results are supported by the behaviour of inflation during the period following the launch of unconventional financing. Indeed, a first installment of unconventional financing amounting to 570 billion DA was released during the month of October 2017. Followed by a second installment amounting to 1,615 billion DA in November 2017. According to the ONS, consumer prices increased by +4.9% in December 2017 compared to December 2016. It is difficult to attribute this increase directly to

unconventional financing, given that from December 2015 to December 2016, consumer prices recorded an increase of almost +7.0%. Furthermore, despite the four installments released in 2018 with a total outstanding amount of 3371.2 billion DA, consumer prices recorded an increase of only 2.7% in December 2018 compared to December 2017.

It would also be relevant to examine other long-run theoretical restrictions, with the aim of analyzing their potential implications for our model. In this regard, the quantity theory of money predicts that in the long term there is an orthogonality between monetary growth on the one hand and growth in production on the other hand, meaning that economic growth is not affected by monetary growth. However, the quantitative theory of money underlines the existence of a proportional relationship between money supply and inflation. Indeed, economic theory teaches us that in the long term, there is proportionality between monetary growth and inflation, meaning that when the money supply increases by x%, inflation also increases by x%. The following results examine these theoretical developments for the Algerian economy.

Figure 3: Impulse responses to an unconventional monetary shock (long-run restrictions).



Source: Prepared by the two researchers based on Eviews.

The above results show that the unconventional monetary shock is not transmitted to the money supply, neither in the short run nor in the long run. Furthermore, this unconventional monetary policy shock has no impact on inflation (insignificant shock). However, by imposing the orthogonality restriction between monetary growth and production growth in the long-run, we see a negative impact, but which is statistically insignificant, of unconventional financing on short-run growth.

5. Discussion:

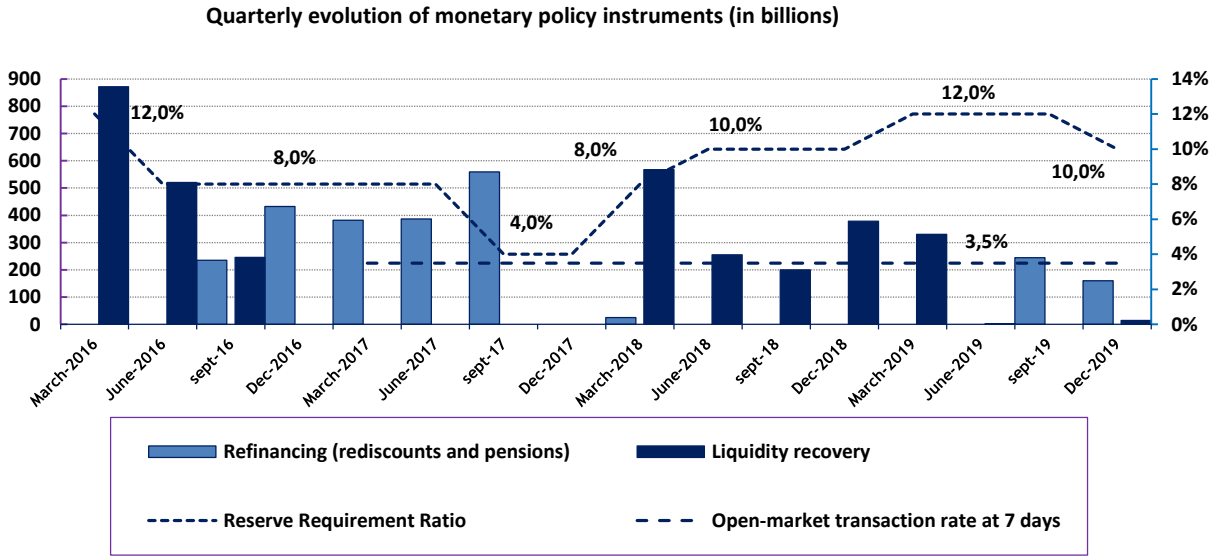
According to traditional textbooks (Mishkin 2010), expansionary monetary policy should lead to a decline in the credit multiplier. Specifically, when interest rates fall, households typically hold more fiat money than bank deposits. As a result, less liquidity returns to the financial sector, reducing the capacity to provide loans and therefore the credit multiplier as well. By analogy with the Algerian economy, we observe a phenomenon close to this theoretical analysis. Indeed, in recent years we have seen a fall in the credit multiplier (from 2015), due mainly to the growing demand for cash balances and the sterilization operations carried out by the Bank of Algeria.

Relatively to cash balances in emerging and developing economies, it's is used both for transactions and as a store of value function, particularly for hoarding purposes[‡]. The increase in the relative share of high-denomination banknotes in the stock of fiat money suggests a growing trend toward using cash as a store of value rather than for current transactions. This analysis could explain, essentially, the liquidity stress at counters of Algeria Post at the beginning of the 2020 pandemic crisis, despite the significant share of fiat money in the money supply. In this regard, despite this significant influx into fiat currency, inflation in 2020 reached only 2.4%, one of its lowest levels in decades.

Furthermore, the "financial curse" has supported the reduction of the credit multiplier: banks do not need to resort to refinancing but instead obtain a relatively high risk-free return, by investing in securities issued at sterilization purposes. Indeed, to

[‡] The outflow of fiat money (autonomous liquidity factor) outside the banking system is detrimental to banking intermediation.

contain inflation at appreciable levels, the Bank of Algeria played a determining role, through sterilization instruments; Following the introduction of unconventional financing, the Bank of Algeria resorted to the activation of liquidity absorption operations at different maturities combined with active management of reserve requirement ratio (see figure below). for the Bank of Algeria, the operations aimed at absorbing excess monetary liquidity, starting in 2002, have effectively helped to contain the inflationary effects of the increase in hydrocarbon resources. In this regard, it can be argued that the operations to absorb excess monetary liquidity, starting from the early months after the release of unconventional financing, helped to mitigate the inflationary effects of this financing mode.



. **Source**: Bank of Algeria.

Conclusion:

The objective of our study was to examine the impact of unconventional financing on economic growth and inflation in Algeria. The transmission of unconventional financing can be analyzed according to the money multiplier principle. According to this multiplier principle, a change in the monetary base should translate into a change in the money supply, and therefore an increase in inflation. To investigate this credit multiplier principle, we estimated a structural vector autoregressive model (SVAR) for the Algerian

economy, covering the period from 2006 to 2022 with quarterly data. Our results highlight that the shock induced by unconventional financing is not transmitted to the money supply and inflation, neither in the short run nor in the long run, even when imposing theoretical restrictions, based on the quantity theory of money. Furthermore, unconventional monetary shocks have no effect on real variables (economic growth).

These results may reflect, perhaps, the structure of the Algerian economy, which is characterized by the fact that market mechanisms take time to be realized. The predominance of the welfare state and the non-diversification of the economy distort some economic realities: subsidies, the dominance of State-owned banks and heavy dependence on volatile hydrocarbon prices. Furthermore, this counterintuitive result, which highlights the non-transmission of the unconventional monetary shock to inflation, can be explained by the weights making up the consumer price index. The updating of the index is required. The weightings should be revised to create a representative basket of household consumption. In fact, perceived inflation by a large part of households differs from officially measured inflation.

At the same time, inflation suppressed by upstream and downstream subsidy mechanisms hide the real repercussions of economic and monetary shocks. However, the sustainability of the situation in the medium and long term is difficult. Indeed, the Balance Sheet of the Bank of Algeria, for recent years, confirms the shift from a situation of foreign exchange reserve holder to the situation of " Treasury securities holder ". In such a situation, preserving the value of the national currency would be difficult. Also, several other interpretations must be examined. For instance, in recent years we have observed a decline in the credit multiplier, mainly induced by the growing demand for cash holdings and the sterilization operations conducted by the Bank of Algeria. Indeed, the “financial curse” combined with the "leak" of liquidity outside the banking system could explain the non-transmission of unconventional monetary shocks.

As a conclusion, we can say that our results are in line with empirical studies evaluating the impact of unconventional financing in Algeria. In addition, our work has shown that theoretical expectations relating to the harmful consequences of

unconventional financing in Algeria, mainly those relating to three or four-digit inflation, are very far from actual realizations (the observations). Furthermore, the Bank of Algeria played a decisive role, through sterilization instruments, to contain inflation at appreciable levels, thus avoiding the scenarios observed in countries like Venezuela and Zimbabwe.

Appendices:

Table 1: Stationarity of the series in level

Variables	Test	The null hypothesis	Trend	Constant	Unit root test (at the 5% level	Results
GDP growth	ADF	non stationnary	Non significant	significant	-3.98 < -2.90	**the time serie is stationary**
	Philips-Perron	non stationnary	Non significant	significant	-3.98 < -2.90	**the time serie is stationary**
Monetary base	ADF	non stationnary	significant	-	-1.92 >-3.48	**the time serie is non stationary**
	Philips-Perron	non stationnary	significant	-	-2.11 >-3.48	**the time serie is non stationary**
Money supply (M2)	ADF	non stationnary	significant	-	-3.00 >-3.47	**the time serie is non stationary**
	Philips-Perron	non stationnary	Non significant	Non significant	6.11> -1.94	**the time serie is non stationary**
CPI	ADF	non stationnary	significant	-	-3.08 >-3.48	**the time serie is non stationary**
	Philips-Perron	non stationnary	Non significant	Non significant	8.40 >-1.94	**the time serie is non stationary**

The source: Prepared by the two researchers based on Eviews.

With the exception of GDP growth, all other variables are non-stationary in level, hence the need to make them stationary through differentiation.

Table 2: Stationarity of first-difference series:

Variables	Test	The null hypothesis	Trend	Constant	Unit root test (at the 5% level	Results
Monetary base	ADF	non stationnary	significant	-	-11.70 <-3.48	**the time serie is stationary**
	Philips-Perron	non stationnary	significant	-	-11.10 <-3.48	**the time serie is stationary**
Money supply (M2)	ADF	non stationnary	Non-significant	significant	-3.58 <-2.90	**the time serie is stationary**
	Philips-Perron	non stationnary	Non-significant	significant	- 6.45 < -2.90	**the time serie is stationary**
CPI	ADF	non stationnary	Non-significant	significant	-3.33 <-2.90	**the time serie is stationary**
	Philips-Perron	non stationnary	significant	-	-8.37 <-3.48	**the time serie is stationary**

The source: Prepared by the two researchers based on Eviews.

The table above shows that a single differentiation is enough to make the variables stationary.

table 3: choice of the number of lags in the reduced-form VAR model:

VAR Lag Order Selection Criteria
Endogenous variables: DLBASE_M DLMASSE_M PIB_TRIM DLIPC
Exogenous variables: C DUMMY
Date: 10/02/23 Time: 16:55
Sample: 2006Q1 2022Q3
Included observations: 60

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-528.4971	NA	686.6526	17.88324	18.16248*	17.99247
1	-497.4881	55.81634	417.4271	17.38294	18.22067	17.71062
2	-470.6006	44.81235*	293.2628*	17.02002*	18.41625	17.56616*
3	-461.5463	13.88331	378.0641	17.25154	19.20627	18.01614
4	-451.3536	14.26980	478.0754	17.44512	19.95833	18.42818
5	-438.7252	15.99600	572.0331	17.55751	20.62921	18.75902

The source: Prepared by the two researchers based on Eviews.

Most of the information criteria, relating to the choice of the number of delays to include in the VAR model, indicate that the use of two delays is sufficient.

Table 4: autocorrelation of errors:

VAR Residual Serial Correlation LM Tests
Date: 10/02/23 Time: 16:58
Sample: 2006Q1 2022Q3
Included observations: 63

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	13.49782	16	0.6361	0.841506	(16, 141.2)	0.6369
2	17.47046	16	0.3558	1.104133	(16, 141.2)	0.3568
3	14.55124	16	0.5577	0.910462	(16, 141.2)	0.5587

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	13.49782	16	0.6361	0.841506	(16, 141.2)	0.6369
2	39.93001	32	0.1583	1.282151	(32, 156.5)	0.1616
3	51.72692	48	0.3305	1.089126	(48, 148.4)	0.3427

*Edgeworth expansion corrected likelihood ratio statistic.

The source: Prepared by the two researchers based on Eviews.

The above test shows that the errors in our model are not autocorrelated. Indeed, we cannot reject the null hypothesis of the non-existence of autocorrelation between errors.

table 5: error homoscedasticity (without cross-term)

VAR Residual Heteroskedasticity Tests (Levels and Squares)
Date: 10/02/23 Time: 17:06
Sample: 2006Q1 2022Q3
Included observations: 63

Joint test:

Chi-sq	df	Prob.
160.1548	170	0.6944

Individual components:

Dependent	R-squared	F(17,45)	Prob.	Chi-sq(17)	Prob.
res1*res1	0.139721	0.429917	0.9696	8.802397	0.9463
res2*res2	0.197883	0.653033	0.8297	12.46665	0.7711
res3*res3	0.499287	2.639517	0.0048	31.45506	0.0176
res4*res4	0.212027	0.712269	0.7740	13.35772	0.7119
res2*res1	0.337612	1.349175	0.2078	21.26953	0.2145
res3*res1	0.166132	0.527376	0.9241	10.46633	0.8829
res3*res2	0.213703	0.719428	0.7670	13.46329	0.7047
res4*res1	0.174663	0.560189	0.9031	11.00380	0.8564
res4*res2	0.215168	0.725712	0.7607	13.55557	0.6983
res4*res3	0.222813	0.758889	0.7270	14.03721	0.6645

The source: Prepared by the two researchers based on Eviews.

The heteroscedasticity test confirms that we cannot reject the null hypothesis that the errors are homoscedastic. In fact, the volatility of our errors is constant over time.

table 6 : error homoscedasticity (with cross-term):

VAR Residual Heteroskedasticity Tests (Includes Cross Terms)
Date: 10/02/23 Time: 17:07
Sample: 2006Q1 2022Q3
Included observations: 63

Joint test:

Chi-sq	df	Prob.
507.5701	510	0.5221

Individual components:

Dependent	R-squared	F(51,11)	Prob.	Chi-sq(51)	Prob.
res1*res1	0.831588	1.065023	0.4881	52.39007	0.4198
res2*res2	0.950939	4.180591	0.0067	59.90915	0.1839
res3*res3	0.984784	13.95947	0.0000	62.04140	0.1383
res4*res4	0.770778	0.725264	0.7884	48.55902	0.5712
res2*res1	0.765784	0.705198	0.8063	48.24437	0.5838
res3*res1	0.823773	1.008225	0.5337	51.89770	0.4387
res3*res2	0.797065	0.847148	0.6762	50.21509	0.5048
res4*res1	0.703312	0.511294	0.9466	44.30866	0.7347
res4*res2	0.730611	0.584964	0.9022	46.02851	0.6710
res4*res3	0.796833	0.845937	0.6773	50.20051	0.5054

The source: Prepared by the two researchers based on Eviews.

The heteroscedasticity test (taking into account the interaction between variables) confirms that we cannot reject the null hypothesis that the errors are homoscedastic. In fact, the volatility of our errors is constant over time.

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