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## Article

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# The Impact of Financial Liberalization on the Effectiveness of Monetary Policy in Algeria

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**Abstract:** The objective of this study is to measure the impact of financial liberalization on the effectiveness of monetary policy in Algeria during the period 1970-2021 using the Autoregressive Distributed Gaps (ARDL) model and analyzing the implications of the financial liberalization policy on the monetary delivery channels as well. In the context of the liberalization of the financial sector, both channels of the exchange rate and financial assets play an effective role in transferring the impact of monetary policy to the real sector compared to the channels of interest rate and bank lending, with central banks relying on the use of indirect tools that depend on market forces to manage their monetary policy. The results of the study also concluded that the policy of financial liberalization represented in loans granted to the private sector as a percentage of GDP positively affects the effectiveness of monetary policy and enhances its ability as a tool to direct the economy towards achieving the goal of economic growth.

**Keywords:** financial liberalization; monetary policy channels; economic growth; ARDL model.

## Introduction

Monetary policy plays a vital role in influencing macroeconomic variables by achieving monetary stability (fighting inflation) or addressing economic imbalances resulting from economic circumstance (economic stagnation and unemployment) (Haddadi, 2017). The impact of monetary policy is transmitted to the real sector through the so-called monetary delivery channels or monetary delivery mechanisms. The monetary theory has identified a set of economic variables that play the role of the carrier of changes in the nature of monetary policy (expansionary or deflationary) to the overall variables (GDP, inflation, unemployment and balance of payments), which are: the interest rate bank loan, exchange rate and financial asset prices (Mohan & Patra, 2009).

The relative importance of each channel depends on the structure of the financial sector and the economic environment of the state. The diversity of financial sector institutions, the tools and the degree of competition in it will determine the extent to which the monetary policy tool affects monetary variables such as interest rates on loans, deposits, asset prices and the exchange rate. As for the economic environment, such as the degree of openness to the outside and the degree of competition determine the extent of the impact of previous monetary variables on aggregate demand, output and inflation (Hussein, 2009). However, in light of the economic and financial transformations that the world had witnessed at the beginning of the eighties of the last century, most countries chose to move towards a free economy, which imposed on them a number of reforms that included the financial sector in order to enhance competition between commercial banks, the independence of the central bank, and the liberalization of capital markets (Khan & Sundararajan, 1991). In the midst of these major financial transformations, especially the policy of financial liberalization, the role of monetary policy has been badly touched in

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affecting the real economy due to the impact of the monetary delivery channels on the change in financial legislation, which mainly included the liberalization of interest rates, the reduction or cancellation of compulsory reserves, as well as the liberalization of capital movement (Faouzi, 1999).

At the beginning of the nineties, Algeria, like many developing countries, carried out radical financial reforms that were adopted within the recommendations of the international financial institutions (the World Bank and the International Monetary Fund) to get out of the economic crisis in that period. The aim of these reforms was to reactivate the role of financial intermediation in the process of economic development by cancelling the restrictions imposed on commercial banks previously during the socialist economic system, especially selectivity in granting loans and giving priority to some economic sectors. The banking reforms in Algeria, which were approved in the Code of Money and Loan in 1990 (Boudebouda & Messedaa, 2022), included liberalizing the banking market by allowing the entry of foreign banks into the Algerian market, liberalizing banking activity that enables banks to finance economic projects according to the principle of entitlement and profitability and not on the basis of priority, as well as the possibility of using New financial products, especially in attracting family savings, liberalizing interest rates, and applying the rules of caution to maintain the integrity of the banking system. Therefore, in light of these transformations in the banking system, monetary policy in Algeria faces challenges related to its effectiveness in influencing economic activity, and this leads us to state the following problem: How effective is the transmission of monetary policy effects in Algeria in light of financial liberalization? In order to answer the problem, we adopted only one hypothesis: *H1. Financial liberalization enhances the effectiveness of the monetary policy.*

The objective of this work is the analysis of the repercussions of the financial liberalization policy on the channels of monetary delivery in Algeria. The paper will be structured in three sections as follows. The first section will be we touched on the channels of monetary policy, followed in the second section, by the impact of financial liberalization on the channels of monetary policy. As for the third section, the impact of financial liberalization indicators was measured on the effectiveness of monetary policy in Algeria for the period 1970-2021.

### **Monetary policy channels (monetary delivery mechanisms)**

The effects of monetary policy are transmitted to the economy through certain channels to achieve the objectives of the economic policy. These channels are the main link between monetary policy changes and their ultimate goals as follows.

#### ***Interest rate channel (monetary channel)***

Interest rates are the main channel for the transmission of the impact of monetary policy in Keynesian thought, and this is demonstrated by the IS-LM model, which represents the instantaneous equilibrium in the goods and services markets and the money market in a closed economy, which illustrates the effects of monetary expansion as shown in the relationship (01) of Figure N° 01 below where M indicates the behavior of an expansionary monetary policy, which leads to a fall in real interest rates (ir) and the cost of capital falls, which leads to an Increase in investment spending (I), and thus an increase in aggregate demand and hence production (Hassani, Barbari, & Ferradji, 2021).

The interest rate channel is based on the real rather than the nominal rate as it influences the decisions of consumers and investors and hence on spending in the long run, not the

short run (Mishkin, 1996), but under the assumption of rigidity of prices, a decrease in the nominal short-term interest rate will lead to a decrease in the interest rate short-term real interest rate, which leads to a decrease in the long-term real interest rate (Ireland, 2010).

This relationship finds its explanation in the theory of expectations related to the structure of interest rates, which sees that the long-term interest rate is equal to the average of the expected short-term interest rates in the future, that is, a decrease in short-term real interest rates will lead to a decrease in the long-term real interest rate, which in turn will lead to an increase aggregate consumption and investment demand, and consequently an increase in real output accompanied by a changing in prices (Chalghoum, 2017).

At minimum nominal interest rates, growth in money supply ( $M$ ) is likely to raise the expected price level ( $P_e$ ) and thus expected inflation ( $\pi_e$ ), resulting in lower real interest rates ( $i_r$ ) even when the price nominal interest fixed at zero, and stimulating spending through the above interest rate channel as shown in relationship N° (02).

### ***Credit channels***

The credit channel has the potential to play an important role in addressing the issue of monetary policy transmission mechanisms; the credit channel is divided into two sub channels: (Farajnezhad, 2022).

#### ***Bank loan channel***

The adoption of an expansionary monetary policy increases the volume of reserves and deposits ( $Db$ ) with banks, which allows an increase in available bank loans ( $P_b$ ). This results in an increase in investment spending ( $I$ ) and consumption as well, and thus increases the domestic product ( $Y$ ) (Boukhatem & Djelassi, 2022). It can be the greatest impact in this case on small projects that usually do not have any other sources of financing other than bank credit, and the impact of the expansionary monetary policy is through the bank credit channel according to relationship N° (03) (Benamra, 2020).

#### ***Budget channel***

Low interest rates as a result of adopting an expansionary monetary policy, which leads to a rise in the market prices of financial and real assets, i.e., the expected rise in the returns expected to be obtained from the assets of economic units, and consequently, a rise in the net wealth of these units and a decrease in the external financing premium, which is positively reflected on their ability on borrowing. The volume of its investment spending (financial and real) as well as its consumer spending increases. Consequently, the volume of aggregate demand increases and the volume of GDP rises (Bakbak, 2012).

### ***Financial asset prices channel***

The prices of financial assets (shares) and real ones (real estate) play a major role in transmitting the effects of monetary policy, whether by influencing the level of investment (productive, building real estate and buildings) or influencing the consumption of the household sector. In both cases, an expansionary monetary policy leads to an increase in the prices of financial and real assets, which in turn leads to an increase in investment and consumption (Ouchchikh, 2018).

### Investment

Tobi's theory shows that the expansionary monetary policy leads to a rise in stock prices as a result of an increase in demand for it, which is positively reflected in the rise in the value of the Q coefficient, which is the ratio between the market value of the company (V) and the renewal of the capital (K). It can be expressed mathematically as the coefficient is the following relationship  $Q=v/K$ , which means the expansion of companies in productive investments financed by issuing new shares, relationship N° (04).

The previous relationship can be dropped on investment in real estate (the channel of housing and land prices), and therefore the Q-factor related to real estate is the product of dividing the price of the old real estate by the cost of building a new one. Building a new property means an increase in the Q coefficient, which leads to an increase in companies' investments in building new properties. In both cases, the investment and the real output increase according to relationship N° (05) (Chalghoum, 2017).

### Consumption

Modigliani's theory provides another mechanism to explain the transmission of the effect of monetary policy, as financial and real assets are considered part of the wealth of the families sector, and therefore their consumption is affected by the value of these assets, so the adoption of an expansionary monetary policy is reflected in the rising prices of these assets, which increases the income of families. This is reflected positively in the increase in consuming demand and real output (Chalghoum, 2017). We can express this according to the relationship N° (06).

### Exchange rate channel

Under the rule of a flexible exchange rate system and the free movement of capital, the expansionary monetary policy leads to a decrease in domestic real interest rates compared to the global interest rate (Ouchchikh, 2018), which leads to an outflow of capital and a decrease in the demand for the local currency, and consequently a decrease in the exchange rate. Its value and the rise in the exchange rate (Bakbak, 2012) are reflected in two effects. The first is the reflection of the depreciation of the currency in an increase in import prices, which in turn leads to a rise in the local inflation rate whereas, the second, the depreciation of the currency leads to an increase in the competitiveness of export industries, leaving an increase in real output (Chalghoum, 2017) (Figure 1).

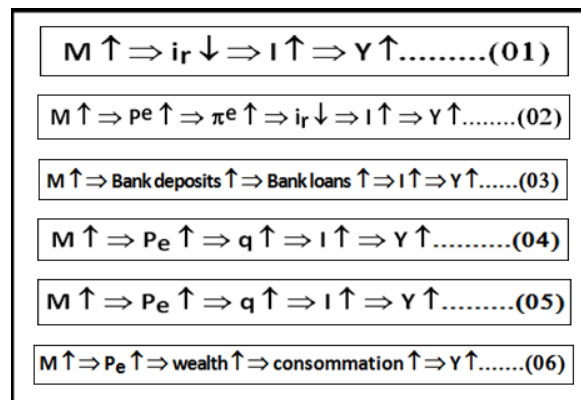


Figure 1. Mechanism of cash delivery

Source: own processing

### **The impact of financial liberalization on monetary policy channels**

There is consensus that financial sector reforms and changes including financial deregulation, innovation and competition are leading to shifts in credit, banking, and financial markets, which in turn affect the effectiveness of monetary policy transmission (Yang & Shao, 2016), and Therefore, financial liberalization is likely to have a clear and significant impact on the monetary transfer mechanism (monetary policy transmission channels), the formulation of central bank programs and the final implementation of monetary policy (Ray, Joshi, & Saggar, 1998).

#### ***The impact of financial liberalization on the interest rate channel***

Financial reforms, liberalization of interest rates and the flexibility of capital movement, especially those related to short-term private loans, have led to more fluctuations and less predictability in domestic interest rates, since the liberalization process provides a great deal of flexibility for commercial banks and other financial institutions to adjust their interest rate policies to suit their financial strategies and environments.

Therefore, the task of maintaining stable prices in financial markets has become increasingly difficult. In addition, although domestic interest rates are the main channel of monetary policy, they are largely affected by foreign interest rates, as external factors play an important role in determining domestic interest rates. This was confirmed by (Sirivedhin, 1998) in his study of Thailand using the VAR model, that the “interbank interest rate shock” has no effect on private investment because of the greater dependence on foreign financing.

Besides, after the liberalization of financial markets, control of interest rates is no longer possible with the fixed exchange system and the free movement of capital, (Mende's triangle of incompatibility or the triangle of opposition to Mendel). The monetary policy aims to reduce interest rates and this increases the outflow of capital flows, which leads to a decrease in the money supply and thus higher prices.

In the same context, (Coudert & Mojon, 1995) tried to know the impact of financial liberalization and structural and financial changes in European countries (Germany, France, Italy and Britain) on the channels and effectiveness of the monetary policy, as they relied on their analysis of the impact of shocks monetary policy on the real economy on the model (VAR) for the period from 1976 to 1993. They concluded that the effectiveness of the monetary policy influence channels in light of financial liberalization differs from one country to another. While the interest rate channel played an important role in France, Italy and Germany, the exchange rate channel in Britain dominated the transmission mechanism. While in a recent study by (Li & Liu, 2019) they measured the effect of interest rate liberalization on the effectiveness of monetary policy transmission in China for the period 1995 to 2017, using the Automatic Distributed Lag (ARDL) test. Their results were positive. The reforms which affected the Chinese banking system, including the removal of controls on the interest rate, in addition to the intense competition in the banking industry, the entry of foreign banks and non-bank financial institutions strengthened the process of monetary policy transmission, as they emphasized the effectiveness of the interest rate channel in light of financial liberalization.

#### ***The impact of financial liberalization on the exchange rate channel***

Murinde (2010) shows that as a result of financial liberalization, large capital flows have led to macro-instability, high inflation and escalation of tensions between the open capital account, the independence of monetary policy and the competitive exchange rate in

Zambia and Uganda and the complexity of monetary policy behavior, which required African countries to manage it effectively by adopting sterilization policy, which contributed to maintaining monetary stability in the short term, and the continuation of inflows. It increased capital movement for some Asian countries requiring the adoption of methods with more flexible exchange rates, as the latter is an important channel for transmitting the effects of monetary policy in light of the liberalization of financial markets (Corker & Tseng, 1991).

Chow, Kriz, Mariano, and Tan (2007) tried to analyze the impact of financial liberalization on exchange rate trends and its response to monetary and real shocks in East Asian countries during the period 1994 to 2005, where they explained that liberalization of the capital account increases the repercussions of the destabilizing external financial shocks, which are reflected in the fluctuation of exchange rates.

Capraro and Panico (2021) also supported the above, that the processes of financial liberalization made the control of exchange rate volatility a major measure of monetary policy, which led to the protection of the national economy from international speculation, but under the financial crisis that Mexico was exposed to in 1994-1995, abandoned the "crawling regime" to "move to the floating system", but the adoption of this system indicates that financial liberalization has reduced the ability of monetary authorities to control the exchange rate and the failure of central banks to "target the nominal exchange rate" Thus, financial liberalization has been reflected in the effectiveness of monetary policy through the exchange rate channel.

### ***The impact of financial liberalization on the asset price channel***

#### ***Real asset prices***

In a study conducted by Iacoviello and Minetti (2003), it was explained that the indirect role that financial liberalization plays in modifying the sensitivity of house prices to monetary policy actions by analyzing and testing the effect of financial liberalization on the relationship between Monetary policy and housing prices in Finland, Sweden, and the United Kingdom during the period 1978-1999, using a vectorized automatic regression (VAR) model. Given the importance of housing wealth in household and corporate portfolios, housing markets played a major role in transmitting the impact of monetary policy, and the results showed the housing price response. Interest rate shocks, especially in periods characterized by more liberal financial markets, where the higher the degree of financial liberalization of the economy, the greater the impact of monetary policy shocks (interest rates) on housing prices.

#### ***Financial asset prices***

Financial globalization is linked to the ongoing structural changes (international integration of financial markets and openness to international capital flows based on liberalization and deregulation), which increases uncertainty about macroeconomic indicators and data and the monetary policy transmission mechanism, as these changes work on the promotion of financial market volatility and rapid capital flow volatility as a result of optimal portfolio allocation to rational agents, forecasting errors committed by investors while processing new information can lead to financial fluctuations that are directly in line with the globalization of financial markets and to greater fluctuations in capital flows without fundamental reasons. Accordingly, asset prices will also know increasing fluctuations, which will have an impact on each of the prices, then on aggregate demand, down to inflation and the management of monetary policy, and then on real economic activity (Wagner, Berger, & Taylor, 2003) Financial prices play an important

role as a channel for transmitting the impact of monetary policy and are the best indicator of the expected economic result in light of the liberalization of financial (...) (the sentence is incomplete) (Blundell-Wignall, Browne, & Manasse, 1990).

### ***The impact of financial liberalization on the wealth channel***

Financial liberalization increased the expansion and diversification of financial assets in investment portfolios in the families and companies sectors, doubling the stock market capitalization, the rise of the stock index and the widening of the participation of foreign investors significantly.

According to the study conducted by (Sirivedhin, 1998) in Thailand, it was found that the rapid rise in wealth has a negative correlation with the average household saving propensity (ratio of household saving to income) in contrast to the contribution of the corporate sector to private saving, and that wealth has a strong influence on saving behavior families that must be a major consideration in managing monetary policy during the period of financial liberalization.

In addition, the liberalization of financial markets increases the acquisition of foreign assets by domestic investors and strengthens (foreign) wealth channels for monetary transfer and increases the control of monetary policy on domestic spending as deregulation enhances the impact of exchange rate assessment (caused by monetary policy) on foreign income for the local investor and his wealth. Hence, this form of liberalization enhances (foreign) wealth channels for the transmission of monetary policy (Meier, 2013).

### ***The impact of financial liberalization and banking competition on the bank lending channel***

#### ***The impact of banking competition on the bank loan channel***

By abolishing and removing restrictions and obstacles that hinder the establishment of local and foreign banks, banking competition is liberalized and state-run banks are restructured and transferred to the private sector, while giving banks and financial institutions their independence and not imposing any restrictions on freedom of entry and exit from the monetary and financial services industry (Sobky & Borusheh, 2018). Banking competition can affect the effectiveness of monetary policy by enhancing or discouraging the bank loan channel, as some studies have shown (Beck, Demirgüç-Kunt, & Maksimovic, 2004; Cetorelli & Strahan, 2006) that increased competition in the banking sector can lead to low prices of financial products and easy access to financing (bank lending).

Yang and Shao (2016) also investigated how competition affects the reaction of bank loan offer to monetary policy through the bank loan channel in China during the period from 2003 to 2014. They found in their study a positive relationship between banking competition and loan growth (easy access to loans). Increasing banking reform and liberalization may have long-term benefits for borrowers and provide more stable and long-term relationships. The results also showed that banking competition may also limit the effectiveness of monetary policy tools (compulsory reserve ratios and rates Lending), forcing the government to rely on fiscal policy or adopt alternative monetary policy tools such as the open market. Hence, banking competition weakened the impact of monetary policy on bank loans in China.

Mahathanaseth and Tauer (2019) also examined the case of monetary policy transition in Thailand for the period 2007-2016, researching the strength of the bank loan channel in



an emerging economy that sought to liberalize its financial sector, to verify the validity that continued financial development reduces. The role of the mediator for the banking sector, as well as its role as a channel for transmitting monetary policy, and the extent to which intense competition contributes to facilitating the passage of interest rates and enhancing the impact of the policy price on interest rates in the banking sector, and the impact of monetary policy through the bank lending channel. The results reached an increase and speed in the impact of the policy rate on loan and deposit rates, which may be attributed to the increase in competition and the impact of monetary policy through the bank lending channel. Therefore, despite the continuous development and liberalization of the Thai financial sector, the Bank of Thailand can implement monetary policy in an effective way to control the fluctuations of the real economy in the short and long term, through interest rate adjustments that are transmitted to consumer and investment spending.

#### *The impact of financial liberalization on the bank loan channel*

Financial liberalization stimulated the growth of the financial sector and the strengthening of the link between local and foreign markets, which was held by the Monetary Policy Department, as it confirmed the results of Sirivedhin (1998) in his study of the local credit shock in Thailand. For the period 1980-1996 using the VAR model, the absence of the impact of monetary policy on the private investment index and the consumer price index, in addition to the difficulty of monitoring the credit of commercial banks in parallel with the increasing demand for direct financing and external borrowing, and the ease of access of borrowers to foreign loans at a lower cost compared to domestic borrowing in parallel. In light of these developments, the effectiveness of the influence of the domestic credit channel has weakened.

Sengupta (2014) adds that despite the importance of the bank loan channel in transmitting the impact of monetary policy in India, it declined and weakened in the post-financial reforms period. This is due to the increase in alternative sources of financing such as investment in government securities.

#### *The impact of financial liberalization on the budget channel*

Financial innovation is one of the forms of financial liberalization and financial development. The monetary economics literature considers that the high rate of financial innovation has reduced the ability of central banks to influence the real economy, and in order to ascertain the negative relationship between financial innovation and the effectiveness of financial innovation. Monetary Policy, Aysun and Hepp (2011) investigated the relationship between securitization and the strength of the bank loan channel to convey the impact of monetary policy focusing on the balance sheet channel.

It has been found that there is a positive relationship between securitization and the balance sheet channel, where banks that securitize their financial assets are more sensitive to the budget channel of borrowers in addition to their flexibility in monetary policy, due to the high sensitivity of securities prices to policy rates. For this reason, this study explains the importance of securitization to the effectiveness of the monetary policy. It suggests that developments that may affect the growth/deepening of the securitization market (e.g., tighter regulation in the wake of the recent crisis) should be taken into account when formulating monetary policy.

***The impact of financial liberalization on the demand for money***

As a result of structural changes, new technology and financial innovations, the effective role of electronic money has emerged, as the increasing use of it leads to obscuring the importance of traditional monetary aggregates. So, the central bank becomes more ambiguous about the monetary transfer mechanism, that is, about how monetary tools affect inflation and economic activity, in terms of size and timing, and consequently, their monetary aggregates lose their role as an intermediate tool and objective of monetary policy (Wagner & Berger, 2004).

As noted by researchers (Khan & Sundararajan, 1991) are the major innovations and reforms in the financial sector led to significant shifts in the behavior of various monetary and credit aggregates. It is preferable to target interest rates in times of major shocks to the real economy rather than monetary aggregates.

Financial innovation has changed the behavior of monetary policy and moved from focusing on monetary aggregates to focusing on interest rates (Peek & Rosengren, 2010).

***The impact of financial crises and financial instability on the channels of monetary policy transmission***

There are many studies that have concluded that most of the financial crises that occurred were preceded by the adoption of the policy of financial liberalization without any appropriate regulatory and supervisory framework to accompany it, which resulted in the occurrence of banking crises and then financial crises, and this latter, in turn, affects the transmission of monetary policy due to the lack of liquidity in the financial markets, macroeconomic volatility, uncertainty and low investor confidence in the market, and fundamental adjustments in the balance sheet of families. All of these adverse characteristics may weaken the transmission of monetary policy. In light of the financial crises, banks refrain from offering their own credit to avoid the risks of non-payment and to adjust their balance sheets after previous losses. Financial crises are usually preceded by bubbles in asset prices and excessive credit and consumption. Hence, the supply and demand for credit decreases, regardless of the interest rate determined by the monetary authority, which weakens the role of the credit channel monetary policy, as well as the interest rate channel of monetary policy, because in these circumstances, investors may postpone their investment decisions in a state of uncertainty, so that the latter becomes a major determinant of investment decisions, and monetary policy loses its impact.

On the other hand, monetary policy intervention can be particularly effective, if it can mitigate some of the adverse characteristics of the financial crisis by restoring the functioning of the credit channel and the interest rate channel.

In this regard, Jannsen, Potjagailo and Wolters, (2015) contributed to a study where they carried out to analyze the transmission of monetary policy during the financial crises for the period 1984-2016 using the VAR model. They found that monetary policy shocks have a significantly larger impact on production and prices during financial crises compared to normal times through the credit channel and the asset price channel, in addition to uncertainty and consumer confidence, which indicates that these variables play an important role in the transmission of monetary policy during financial crises.

## Methodology

For the purpose of studying the relationship between financial liberalization and the effectiveness of monetary policy in achieving economic growth and controlling price stability, annual data related to the national economy covering the period (1970-2021), for about 52 observations, were used. And the study of co-integration based on the study of Ma and Lin (2016), takes the following form:

$$Y=f(M2, INV) \quad (01)$$

Where:

- Y = the ultimate goal of monetary policy, expressed in the rate of economic growth.
- M2= the monetary policy variable and represents the monetary channel, expressed by the growth rate of the money supply, where ( $\Delta M$ ), which is calculated as follows:
- $M2_{1970} \% = [(M2_{1970} - M2_{1969}) / M2_{1969}] * 100$
- INV = the control variable and it represents the total investment.

Regardless of the basic model above, an alternative model is used where the interaction variable is included for financial liberalization

Which is displayed in the following way:

$$Y=f(M2, INV, LF, W) \quad (02)$$

Where:

- LF represents the indicator of financial liberalization, which is expressed in the percentage of loans directed to the private sector of the gross domestic product, according to several studies, including Jonung (2009); Alioua and Dadene (2020).
- W=interaction variable for financial liberalization calculated as follows:  $W=M2*LF$  according to the study of Ma and Lin (2016).

## Empirical study

### Stability study of time series using the Augmented Dickey Fuller test

Through the results of the DF test, we note that at the probability value  $\alpha = 5\%$ , all-time series investment, financial liberalization, interaction variable are stable after the first difference and integrated series of the first degree (INV, LF, W)  $\{1\} \in I$ , while the rate of economic growth and the growth rate of the money supply are stable time series at the level (Y, M2)  $\{0\} \in I$ , which indicates that they move together through time and that there is a long-term time relationship known as the cointegration test (Table 1).

**Table 1. Results of the time-series stability test for the study variables**

VARIABLE	Level			1 <sup>ST</sup> Difference			Stationary
	Constant & Trend	Constant	NONE	Constant & Trend	Constant	NONE	
Y	0.0000	0.0000	0.0224	/	/	/	I(0)
M2	0.0000	0.0002	0.2128	/	/	/	I(0)
INV	0.7517	0.4655	0.6059	0.0000	0.0000	0.0000	I(1)
LF	0.7181	0.5669	0.3125	0.0005	0.0001	0.0000	I(1)
W	0.0005	0.7399	0.2017	0.0000	0.0000	0.0000	I(1)

Source: own processing based on EVIEWS10 data.

## Basic model

### Cointegration Test:

Based on the time series stability test for the study variables, it was found that the variables are integrated of degrees  $I(0)$  and  $I(1)$ . These results indicate the possibility of using the ARDL method in our study to search for the relationship between financial liberalization and economic growth in Algeria.

### Determining the optimal delay period for the ARDL model

To determine the optimal delay period for the model, we use the following criteria, which are Log L, LR, FPE, HQC, SBC and AIC, which are shown in the following figure.

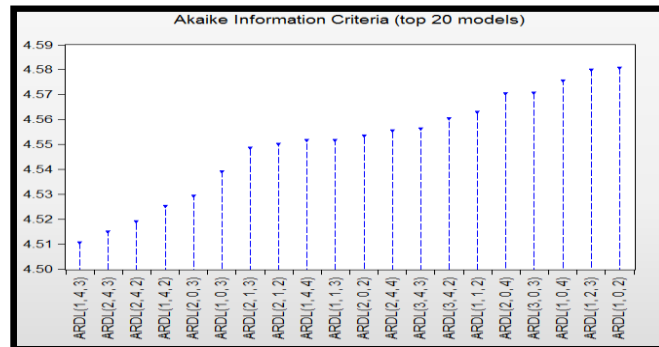


Figure 2. Determination of the optimal slowdown period for the ARDL model

Source: own processing based on EViews10 data

It is clear from the previous figure that the best model according to the (AIC) standard is ARDL (1, 4, 3).

### Bounds test

After making sure that the model is capable of estimation, we will conduct a bounds test as shown in Table 2.

Table 2. Boundary test

F-Bonds Test Null hypothesis: No level relationship				
Test Statistic	Value	Sig.	I(0)	I(1)
F – Statistic	6.688501	10%	2.63	3.35
K	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5

Source: own processing based on EViews10 data

Through the table, we note that the statistical value of Fisher lies outside the domain  $I(0)$  and  $I(1)$  and at the level of significance of 1%, 5%, 10%, which means accepting the alternative hypothesis  $H_1$  and rejecting the null hypothesis  $H_0$  which states that there is no equilibrium relationship Long-term because the calculated F values (6.688501) are greater than the upper limit of the critical values. This means that there is a long-term relationship between the study variables. A long-term equilibrium is achieved between them.

### Estimation of the parameters of the model in the long run

Table 3. Estimating the parameters of the model in the long run

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob
M2	0.307019	0.072661	4.225350	0.0001
INV	0.096036	0.055176	1.740540	0.0901
C	-5.269901	2.591076	-2.033866	0.0492
EC=Y-(0.3070*M2+0.0960*INV-5.2699)				

Source: own processing based on EVIEWS10 data

From Table 3, it can be noted that:

- The value of the estimated parameter of the constant is negative (-5.269901) and is statistically significant at 5%.
- In the long run, there is a positive effect (0.307019) and a significant (0.0001) at 5% of the money supply growth rate on the economic growth rate, which is consistent with the economic theory.

The relationship between investment and economic growth is positive and significant at 10%, which is consistent with economic theory.

### Estimation of short-term parameters (error correction model ECM)

We will now try to study if there is a possibility to correct the error from the short term to the long one by studying the parameter of error correction as shown in Table 4.

Table 4. Estimation of the error correction parameter

ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob
D(M2)	0.077737	0.036915	2.105850	0.0421
D(M2(-1))	-0.141800	0.050699	-2.796885	0.0081
D(M2(-2))	-0.099614	0.042616	-2.337481	0.0249
D(M2(-3))	-0.093023	0.035607	-2.612485	0.0129
D(INV)	0.104002	0.085686	1.213748	0.2325
D(INV(-1))	0.287568	0.083981	3.424180	0.0015
D(INV(-2))	-0.149070	0.094451	-1.578288	0.1230
CointEq(-1)*	-0.791017	0.147083	-5.378034	0.0000
R-squared	0.624475	Mean dependent var		0.000721
Adjusted R-squared	0.558759	S.D. dependent var		3.026439
S.E. of regression	2.010343	Akaike info criterion		4.385499
Sum squared resid	161.6591	Schwarz criterion		4.697366
Log likelihood	-97.25198	Hannan-Quinn criter		4.503354
Durbin-Watson stat	1.948214			

Source: own processing based on EVIEWS10 data

The table shows the following results:

- There is a correction in the deviation of the value of the economic growth index means ratio of 79.10% of the short-term errors can be corrected in the long-term by a unit of time in order to return to the long-term equilibrium position, meaning that there is a possibility to return to the equilibrium position.
- Correlation coefficient  $R^2 = 0.62$ , which indicates that the independent variables explain the dependent variable by 62.44%, and the remaining 37.56% are caused by other factors or variables not included in the model that are dependent on the random variable or fall within the margin of error.

**Model validity test ECM: “standard problems”****Table 5. Diagnosis of the model**

<b>Breusch-Godfrey Serial Correlation LM Test</b>			
<b>Null Hypothesis (H0): There is no sequential autocorrelation problem for the residuals of the regression equation.</b>			
0.4596	Prob F (2.35)	0.795018	F-statistique
0.3524	Prob Chi-Square (2)	2.085862	Obs*R-au carré
<b>Heteroskedasticity Test Breusch pagan Godfrey</b>			
The null hypothesis (H0): stability of variance			
0.1624	Prob F (10.37)	1.545757	F-statistique
0.1665	Prob Chi-Square (2)	14.14407	Obs*R-au carré
<b>Normality test Jarque-Bera</b>			
The null hypothesis (H0): the residuals are normally distributed			
0.350886	Prob	2.094590	Jarque-Bera

Source: own processing based on the data of the program (EViews10)

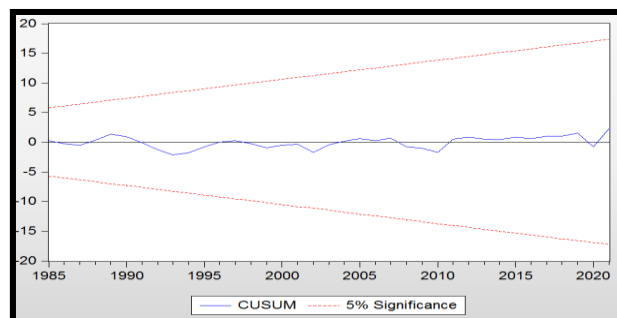
Through Table 5, the results of the diagnostic tests confirm the following:

- The serial residual correlation test indicates that the probability of the F-statistic corresponding to the LM test is  $> 0.05$ , which is 0.4596, from which we accept H0 if there is no autocorrelation of errors and this is good for the model
- Since the probability of the F-statistic corresponding to the Breusch pagan Godfrey test for stability of variance is  $> 0.05$  which is 0.1624, which makes us accept the null hypothesis which states that the residual variance is constant
- Concerning the normal distribution of random errors, the probability of JAQUE-BERA  $> 0.05$  equals 0.350886, which confirms the acceptance of the null hypothesis that the residuals are normally distributed.

Thus, the model is free from standard problems.

**Structural stability test of the model**

Where the model is generally stable, it is necessary that its variables form a stable dynamic system, and for this, the roots of the unit and all coefficients must be smaller than one, which means that the model does not suffer from the problem of correlation errors or instability of variance.

**Figure 3. ECM Structural model test results**

Source: own processing based on the data of the EViews10 program

It can be noted from the figure that the statistic (CUSUM) is located within the roots of the confidence domain and from it, the model is stable throughout the study period.

## The second model

### Determining the optimum deceleration period for the ARDL model

Figure 4 shows that the optimum deceleration period.

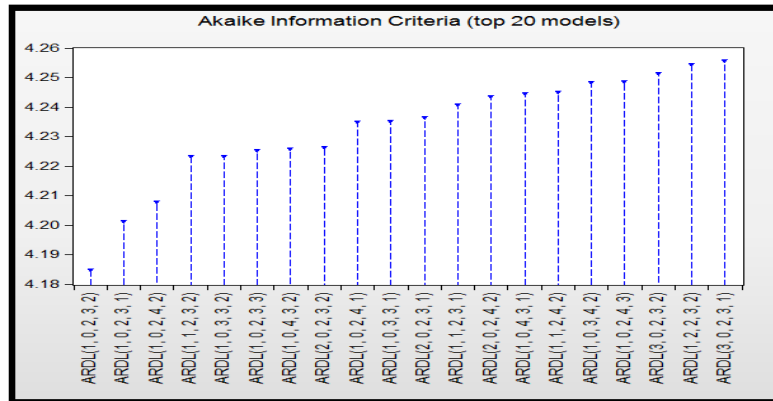


Figure 4. Determination of the optimal slowdown period for the ARDL model

Source: own processing based on EViews10 data

It is clear from the previous figure that the best model according to the (AIC) standard is ARDL (1, 0, 2, 3, 2).

### Bounds test

After making sure that the model is estimable, a Bounds Test was performed as shown in Table 6.

Table 6. Bounds test

F-Bonds Test Null hypothesis: No level relationship				
Test Statistic	Value	Sig.	I(0)	I(1)
F – Statistic	42.76567	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: own processing based on EViews10 data

Through the table, it was noted that the statistical value of Fisher lies outside the domain I(0) and I(1) and at the level of significance of 1%, 5%, and 10%, which means accepting the alternative hypothesis H1 and rejecting the null hypothesis H0 which states that there is no equilibrium relationship Long-term because the calculated F values (42.76567) are greater than the upper limit of critical values. This means that there is a long-term relationship between the study variables, and a long-term balance is achieved between them.

**Estimating the parameters of the model in the long run****Table 7. Estimating the parameters of the model in the long term**

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob
M2	0.037774	0.047719	0.791584	0.4338
INV	-0.034185	0.034411	-0.993446	0.3271
LF	-0.090253	0.02159	-3.450100	0.0014
W	0.005679	0.001490	3.810473	0.0005
C	3.829848	1.706398	2.244405	0.0310
EC=Y-(0.0378*M2-0.0342*INV-0.0903*LF+0.0057*W+3.8298)				

Source: own processing based on EVIEWS10 data

From Table 7, we note that:

- The coefficient of slowed economic growth over a period of time is negative (-1.175957) and significant at 5%, which indicates the existence of joint integration in the long run.
- The value of the estimated parameter of the constant is positive (3.829848) and is statistically significant at 5%.
- In the long run, there is a negative effect (-0.090253) and a significant (0.0014) at 5% of the financial liberalization variable on the economic growth rate, which is consistent with the results of some standard studies that showed an inverse relationship.
- There is a positive effect (0.005679) and a significant (0.0005) at 5% of the interaction variable on the economic growth rate.
- The insignificance of investment on economic growth at 5%, and they have not been proven to have any effect in the long run, which is consistent with some studies, such as the ones conducted by Encinas and Villegas (2015) and Bouffanche (2021).

The insignificance of money supply on economic growth at 5%, and they have not proven to have any effect in the long run.

**Estimation of short-term parameters (error correction model ECM)**

We will now try to study if there is a possibility to correct the error from the short term to the long term by studying the parameter of error correction as shown in Table 8.

**Table 8. Estimation of the error correction parameter**

ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob
D(INV)	-0.013815	0.066261	-0.208494	0.8360
D(INV(-1))	0.293874	0.066870	4.394700	0.0001
D(LF)	0.025667	0.042948	0.597643	0.5538
D(LF(-1))	0.143924	0.045662	3.151933	0.0033
D(LF(-2))	0.115582	0.039329	2.938866	0.0057
D(W)	0.001902	0.000774	2.458710	0.0189
D(W(-1))	-0.001608	0.000735	-2.187838	0.0353
CointEq(-1)*	-1.175957	0.068790	-17.09480	0.0000
R-squared	0.889754	Mean dependent var		-0.481146
Adjusted R-squared	0.870931	S.D. dependent var		4.510669
S.E. of regression	1.620508	Akaike info criterion		3.951639
Sum squared resid	107.6679	Schwarz criterion		4.260507
Log likelihood	-88.81515	Hannan-Quinn criterion		4.068823
Durbin-Watson stat	1.961501			

Source: own processing based on EVIEWS10



The table shows the following results:

- There is a correction in the deviation of the value of the economic growth index, which means a ratio of 117.59% of the short-term errors can be corrected in the long-term with a unit of time in order to return to the long-term equilibrium position, meaning that there is a possibility to return to the equilibrium position.
- Correlation coefficient  $R^2 = 0.88$ , which indicates that the independent variables explain the dependent variable by 88.97%, and the remaining 11.03% are caused by other factors or variables not included in the model that are dependent on the random variable or fall within the margin of error.

**Model validity test ECM: "standard problems"**

**Table 9. Diagnosis of the model**

<b>Breusch-Godfrey Serial Correlation LM Test</b>			
<b>Null Hypothesis (H0): There is no sequential autocorrelation problem for the residuals of the regression equation</b>			
0.9452	Prob F (2.34)	0.056466	F-statistique
0.9221	Prob Chi-Square (2)	0.162215	Obs*R-au carré
<b>Heteroskedasticity Test Breusch pagan Godfrey</b>			
<b>The null hypothesis (H0): stability of variance</b>			
0.6596	Prob F (1.46)	0.196574	F-statistique
0.6513	Prob Chi-Square (2)	0.204248	Obs*R-au carré
<b>Normality test Jarque-Bera</b>			
<b>The null hypothesis (H0): the residuals are normally distributed</b>			
0.000002	Prob	25.98083	Jarque-Bera

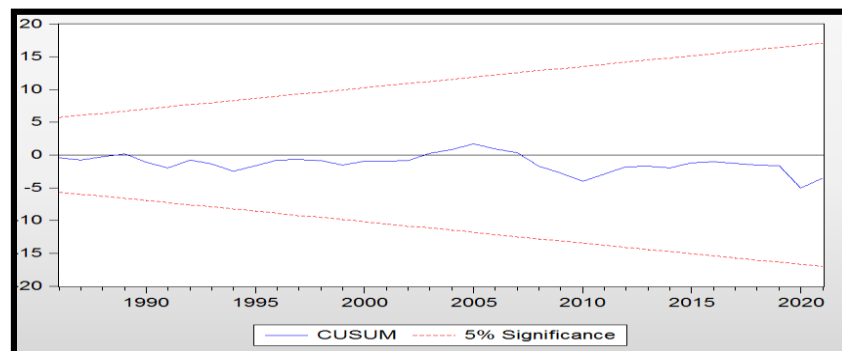
Source: own processing based on EVIEWS10

Through Table 9, the results of the diagnostic tests confirm the following:

- The serial residual correlation test indicates that the probability of the F-statistic corresponding to the LM test is  $> 0.05$ , which is equal to 0.9452, from which we accept H0 if there is no autocorrelation of errors and this is good for the model
- Since the F-statistic probability corresponding to the test for stability of variance ARCH  $> 0.05$  which is equal to 0.6596, we accept the null hypothesis that says the stability of residual variance
- Concerning the normal distribution of random errors, the corresponding statistic for JAQUE-BERA  $> 0.05$  equals 25.98083, which confirms the acceptance of the null hypothesis that the residuals are normally distributed. Thus, the model is free from standard problems.

**Structural stability test of the model**

Where the model is generally stable, it is necessary that its variables form a stable dynamic system. Therefore, the roots of the unit and all coefficients must be smaller than one, which means that the model does not suffer from the problem of error correlation or the instability of variance (Figure 5).



**Figure 5. Structural model test results for ECM**

Source: own processing based on EViews10 data

We note from the figure that the statistic (CUSUM) is located within the roots of the confidence domain and from it the model is stable throughout the study period.

## Results and discussion

Through the long-term and short-term model, the following results were retrieved.

### *Basic model*

A positive significant relationship between the monetary policy variable and the economic growth rate in the long term, where the increase in the growth rate of the monetary mass by one unit leads to a rise in the gross domestic product ratio by 0.3070, as it was found that there is a relationship in the short term after conducting the Wald test (according to Appendix N° 01). Also, there is a direct significant relationship between investment and the rate of economic growth in the long run, where the higher the rate of investment by one unit, the economic growth increases by 0.0960, while in the short term, there is no relationship between them according to the results of Wald's test.

### *The second model*

An insignificant positive effect between the monetary channel and the gross domestic product in the short and long term, and this can be explained that monetary policy loses its impact on the macroeconomic index in light of financial liberalization. Also, the insignificant inverse relationship between the investment variable and economic activity in the long and short term.

The significant negative relationship between the financial liberalization index and the ultimate goal of monetary policy in the long term, as the higher the percentage of loans directed to the private sector from the GDP by one unit, the lower the economic growth rate by 0.0902, while no relationship between them was proven in the short term according to the results of the Wald test. Also, significant direct relationship between the interaction variable (financial liberalization and monetary policy variable) and the monetary policy objective in both the long and short term. Increasing the interaction variable by one unit leads to an increase in the economic growth rate by 0.0056, and this is explained by the fact that financial liberalization increases the effectiveness of the monetary policy.

## Conclusions

Algeria adopted the policy of financial liberalization and its impact at the beginning of the nineties, when it chose to go towards a free economy and adopted a market economy, which imposed on it a number of different reforms that the financial sector knew, and in parallel with these developments, of course, the monetary policy framework is also subject to major changes.

Through our study, we tried to reach the nature of the relationship between the indicators of financial liberalization and the effectiveness of monetary policy in Algeria during the period (1980-2021). According to the results of the time series stability test, it was found that the study variables are independent in the level and after the first difference, which indicates that they are integrated of degree  $I(0)$  and  $I(1)$ , also the quality of the model used in the analysis is that it is free from econometric problems by conducting several diagnostic tests for the model.

The results of the study also revealed that there is a long-term equilibrium relationship between the study variables, and this was confirmed by the Bounds Test, which confirms the existence of cointegration, whereas the indicator of financial liberalization represented in loans granted to the private sector as a percentage of GDP increases the effectiveness of monetary policy in achieving the goal of economic growth. This means that the policy of financial liberalization positively affects the effectiveness of monetary policy and it enhances its ability as a tool to guide the economy towards achieving the goal of economic growth.

Although our experimental results confirmed the validity of the aforementioned hypothesis, it should be noted that the central bank's efficiency in achieving its objectives and the effectiveness of monetary policy channels depend on the degree of financial liberalization, the nature of the liberalized country, and the type of countries' economies.

Therefore, expanding the sample size by increasing the number of countries for different economies (developing, emerging or developed), as well as focusing on all monetary policy objectives (economic growth, inflation, unemployment and balance of payments balance) using other econometric methods (such as panel data model) will allow to develop the study in future research.

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**Appendix****The results of the Wald test for study variables****Basic model**

Results of the Wald test for the monetary mass variable

Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	3.054335	49	0.0036
F-statistic	9.328965	(1, 49)	0.0036
Chi-square	9.328965	1	0.0023
Null Hypothesis: C(2)=0 Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(2)	0.217252	0.071129	

Results of the Wald test for the investment variable

Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	1.312801	49	0.1954
F-statistic	1.723446	(1, 49)	0.1954
Chi-square	1.723446	1	0.1893
Null Hypothesis: C(1)=0 Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(1)	0.110236	0.083970	

**Second model**

Results of Wald test for the variable money supply

Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	-0.084371	47	0.9331
F-statistic	0.007118	(1, 47)	0.9331
Chi-square	0.007118	1	0.9328
Null Hypothesis: C(2)=0 Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(2)	-0.011197	0.132717	

Results of Wald test for the investment variable

Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	0.195916	47	0.8455
F-statistic	0.038383	(1, 47)	0.8455
Chi-square	0.038383	1	0.8447
Null Hypothesis: C(1)=0 Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(1)	0.018362	0.093722	

Results of the Wald test for the financial liberalization index

Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	-1.556411	47	0.1263
F-statistic	2.422415	(1, 47)	0.1263
Chi-square	2.422415	1	0.1196
Null Hypothesis: C(4)=0 Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(4)	-0.100047	0.064281	

Results of the Wald test for the interaction variable

Wald Test: Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	-1.556411	47	0.1263
F-statistic	2.422415	(1, 47)	0.1263
Chi-square	2.422415	1	0.1196
Null Hypothesis: C(4)=0 Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(4)	-0.100047	0.064281	