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Effectiveness of the asset price channel as a transmission mechanism for monetary policy in Morocco: Evidence from a VAR analysis

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Abstract

The stock market has a crucial role in modern economies, serving as a means to diversify domestic sources of funds and provide avenues for productive investments.
The presence of a meaningful correlation between macroeconomic variables and the stock market is crucial for the stock market to fulfill this role effectively.
Various theoretical and empirical models have been used to analyze the relationship between monetary policy and stock prices. The results of these models provide evidence that monetary policy can affect stock prices, and vice versa.
The objective of this paper is to study and analyze the relationship between the stock market (MASI) and monetary policy in Morocco, through a vector autoregression (VAR) model covering the period 2007Q1- 2017Q4.
By analyzing the various empirical studies on the effect of monetary policy on the stock market via the stock price channel, we found that the stock price channel in Morocco is not operational.
The results of our VAR model confirmed this finding. We found that during the studied period, there was no significant relationship between monetary policy and the Moroccan stock market.
These results proved the existence of a dysfunction in the transmission mechanism of stock prices in Morocco, which invalidates our central hypothesis that there is interdependence between the Central Bank and the stock market.
Furthermore, due to the lack of long and sufficient statistical data series, especially the Real Estate Asset Price Index (REAPI), these contributions that we were unable to make will further enhance our work.

Keywords: Transmission mechanism of monetary policy, stock price channel, VAR, impulse response function, cointegration
JEL Classification : E4, E5, G15
Paper type: Empirical research

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1. Introduction

In recent years, central banks in many countries have adopted the strategy of raising interest rates early to prevent inflation from rising as a result of an overheating economy. For this strategy to be successful, the monetary authority must be able to accurately assess the pace and impact of its actions on the economy, which requires an understanding of the mechanism by which monetary policy affects the economy (Mishkin, 1996).

Monetary policy tools affect the real economy through different transmission channels. These mechanisms can be predefined as processes through which monetary policy decisions affect growth and prices.

Economic theory distinguishes two traditional channels for the transmission of monetary policy: the interest rate channel and the exchange rate channel, to which are added the credit channel, the balance sheet channel and the stock price channel (Mishkin, 1996)

The interest rate and asset price channel in the New Keynesian ISLM model are the main transmission mechanism of monetary policy. According to this traditional view, an expansionary monetary policy that leads to a decrease in interest rates reduces the cost of capital, which leads to an increase in investment spending. However, these two mechanisms do not seem to be effective in assessing the transmission of monetary policy because they do not take into account the role of the financial structure (Mishkin, 1996). The normal functioning or malfunctioning of transmission channels allows the Central Bank to verify and determine the ability or inability of its monetary policy tools to affect the real economy (Mishkin, 1996).

The objective of this paper is to study the effectiveness of the stock price channel and its implication on the conduct of monetary policy for the case of Morocco. In other words, is there an interdependency between Bank Al-Maghrib and the Casablanca Stock Exchange?

We have the following hypothesis as an initial answer:

The existence of a positive impact of monetary policy on the stock market. In other words, there is a significant relationship between the monetary policy instrument (The interbank market rate) and the stock market (MASI).

The problem and the hypothesis of our article lead us to ask the following research questions: What is the impact of monetary policy on the stock market? Can we talk about an empirically efficient stock price channel in Morocco?

To be able to answer our question and verify its hypothesis, we will restructure our work as follows:

In the next section, we will present the different theoretical framework and empirical studies conducted to analyze the effect of monetary policy on the stock market.

The third section will present modeling methods that allow us to evaluate the transmission channels of monetary policy by integrating selected variables from an econometric point of view. The purpose of the latter is to justify the choice of using the VAR method, the representation of the model and the different testing and statistical techniques to be used. This third section will present the strategy for studying the stock price channel and the results of the empirical test of our VAR model.
The fourth section will focus on the analysis and explanation of the evaluation results of the stock price channel in Morocco.

2. Literature review and empirical studies

In modern economies, the stock market plays a very important role. As an example, the stock market can help an economy to diversify the domestic market of funds and productive investment channels. For a stock exchange of any country to play this role, the existence of a significant relationship between macroeconomic variables and the stock market is very essential.
Based on the assumptions of efficient markets, investors are expected to possess all the necessary and relevant information regarding their investments. This theory posits that stock prices incorporate the impacts of all macroeconomic variables. (Fama, 1965).
Hence, it is very important to understand the sensitivity of the stock market to its variables in order to recognize the transmission of the monetary policy mechanism to the stock market.
In this section, we will present the theoretical literature and empirical studies showing the effect of monetary policy on the stock market via the stock price channel.

2.1 Theoretical literature

The correlation between monetary policy and the stock market has been extensively examined across various regions globally for a considerable period. A wide variety of theoretical and empirical models have been used to analyze the relationship between monetary policy and stock prices. The result of these models have provided evidence that monetary policy is able to influence stock prices and vice versa.
There are two important channels involving stock prices for monetary transmission; they refer to Tobin's theory of investment (coefficient q) and to wealth effects on consumption.

2.1.1 Tobin's Q channel

James Tobin's theory (1969) can also explain investment decisions.

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Tobin defines a ratio, called "Tobin's Q", which is the ratio of the market value of the firm's shares divided by the replacement cost of capital. When Tobin's Q is too high relative to 1, the market value of the firm is high relative to the replacement cost of capital. This means that the investment is cheaper. Compared to the investment costs, firms can issue new shares at a high price.
Tobin's Q theory can be linked to the cost of capital. For example, Hayashi (1982) showed a direct link between the purchase price of stocks and capital expenditures (Hayashi, 1982). Therefore, Tobin's Q can be seen as another channel of monetary transmission strategy (Tobin, 1969).
When the Central Bank implements an expansionary monetary policy by lowering the policy rate, bond yields fall to entice investors to buy stocks, thus the price of stocks increases. With the increase in demand for stocks, newly issued companies have led to an increase in capital spending. This stock price channel acts as follows:
According to Mishkin (1996), an expansionary monetary policy leads to an increase in stock prices, which in turn leads to an increase in Tobin's q coefficient and thus in investment spending. Ultimately, this leads to an increase in aggregate output (Tobin, 1969).

2.1.2 Wealth Effect Channel

The life-cycle theory of saving and consumption was first proposed by Brumberg and Modigliani (1954) and later by Ando and Modigliani (1963). The later showed that consumption expenditures are caused by saving and consumption and are determined by several factors, including the financial wealth of the consumer or the wealth that may correspond to the portfolio of financial assets (Modigliani & Brumberg, 1954) (Ando & Modigliani, 1963).
Friedman's (1957) analysis showed that real income will never be fixed and that household consumption is more stable over time. The fall in income does not always correspond to the fall in consumption (Friedman, 1957).
According to him, consumption is not only a function of current income, but also a function of income (past income and future income, i.e. the agent's wealth). Consequently, agents do not determine their current consumption on the basis of current income, but on the basis of permanent income, i.e. he defines permanent income as the amount that consumers can use for their consumption while keeping their capital value unchanged.
The changes in monetary policy can lead to an increase in the price of all financial assets or of particular stocks. At the same time, low interest rates have lowered the discount rate on future financial assets flows, leading to higher present values and prices, which will increase the value of household investment portfolios.
The increase in total wealth will stimulate household consumption and aggregate demand. The behavior of the asset price channel is as follows:

As mentioned earlier, expansionary monetary policy can lead to higher stock prices. When stock prices rise, the value of financial wealth gets higher and, as a result, consumers' total lifetime resources increase, which increases their consumption and thus their total output (Mishkin, 1996).
The wealth effect generated through financial asset prices is then considered an important pillar of monetary policy transmission mechanisms, especially in countries with developed capital markets where there is a significant presence of retail investors.

2.2 Empirical literature

Empirically, many economists have examined the question of the effect of monetary policy on the stock market.
Gilchrist and Leahy conducted a study in 2002 and used two shocks that could affect asset prices and the economy to assess appropriate policy responses. They conducted two separate experiments to analyze the impact of these shocks on the effectiveness of monetary policy on asset prices (Gilchrist & Leahy, 2002). The results found that there is no reason to consider stock prices in determining the most effective monetary policy (Iglesias & Haughton, 2011).
In 1995, Mukherjee et al. conducted an assessment of the interplay between stock prices and several macroeconomic factors, including the exchange rate, money supply, industrial production index, inflation, and interest rate. The findings revealed a positive association among these variables, except for inflation and interest rates (Rifat, 2015) (Mukherjee, Tarun , & Naka, 1995).
Similarly, Mansor H. Ibrahim conducted a study in 2003 that attempted to analyze the long-run dynamic interactions between the Malaysian stock market and several economic variables (Ibrahim, 2003). The results revealed a positive correlation between the Malaysian stock market index and economic variables such as money supply, consumer price index and industrial production index. However, in a similar study also showed a negative relationship between the stock market index and the exchange rate (Iglesias & Haughton, 2011).
In 1997, Willem Thorbecke evaluated the effect of monetary policy on stock prices in the United States (Thorbecke, 1997). Using a VAR model and monthly data. His results revealed a small proportion of stock price changes after different policy shocks (Iglesias & Haughton, 2011).
In 2006, Cassola and Marona employed a co-integrated VAR model that incorporated real GDP, inflation, M3, short-term interest rates, bond yields, and real stock prices to investigate the mechanism of stock prices in the Eurozone. Their study revealed that a permanent positive monetary shock would yield a temporary positive effect on real stock prices (Cassola & Morana, 2006).

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In their study, Rahman and Uddin (2009) employed Johnson Cointegration and Granger Causality Tests to analyze the connection between stock prices and exchange rates in three emerging South Asian countries, namely Bangladesh, India, and Pakistan. Their findings indicated the absence of cointegration or causality between stock prices and exchange rates across the different countries (Rahman & Uddin, 2009).

In 2009, Alam and Uddin used a random-effects model to conduct a study in five open countries with growing stock markets for a period from 2004 until 2014 to study the effect of monetary policy on stock markets. The panel regression combines the vector panel error correction model (Panel VECM) to study the short- and long-run relationships between the variables. The findings indicate an inverse relationship between interest rates and stock returns, whereas there exists a positive association between money supply and stock returns (Alam & Uddin, 2009).

Banerjee and Adhikary used the Johansen-Juselius procedure to test the impact of changes in the interest rate and exchange rate (USD / BDT) of the Bangladesh stock market in 2009, using a Vector Error Correction Model (VECM). The results revealed that changes in interest rate and exchange rate affect the stock market in the long run, but not in the short run when the exchange rate and the stock market are almost independent (Banerjee & Adhikary, 2009).

According to the research of Myftari and Rossi (2010), there is a strong correlation between financial stability and monetary and macroeconomic stability. This proves the rationality of including financial stability in the objective of Central Banks and also the implementation of a closer cooperation between monetary authorities and financial supervisors (Myftari & Rossi, 2010).

In 2017, Iddrisu, Harvey and Amidu investigated the relationship between monetary policy and stock market dynamics from an African perspective. In their study which covered the period from 1979 to 2013, they used a panel VAR model and five indicators namely: S&P Global Stock Indices, inflation rate, money and quasi-growth (M2), real interest rate and GDP growth.

The study found that the stock markets of the 12 African countries are positively affected simultaneously by their respective monetary policies through the interest rate channel (Iddrisu, Harvey , & Amidu, 2017).

Lütkepohl and Netšunajev (2018) used a cointegrated structural vector autoregression model to study the relationship of Eurozone monetary policy and the stock market. Their results showed that monetary policy shocks lead to a sustained decline in real stock prices (Lütkepohl & Netšunajev, 2018).

Sashikanta et al. (2019) examine the relationship between monetary policy announcements and stock returns in emerging market economies. Their findings indicate that the Indian stock market responds to both scheduled and

unscheduled monetary policy announcements, as well as unexpected ones. These results support the notion that the transmission of monetary policy through the stock market holds considerable importance (Sashikanta & Gourishankar, 2019).

Edwin Prabu et al. (2020) aimed to analyze the influence of domestic and US monetary policy announcements on sector-specific stock indices using the IH approach through two methods, namely IV and GMM estimators, spanning the period from April 2004 to June 2016. Their research revealed varied impacts of monetary policy announcements on sectoral stock indices, with policy surprises exerting a significant influence on select sectors. (Edwin Prabu, Indranil Bhattacharyya, & Partha , 2020).

Shibamoto and al. (2021) investigated the causal effect of monetary policy using a structural vector autoregression model. The results showed a significant impact of Japanese monetary policy on the financial market from the 1980s onwards. In other words, a change in the short-term interest rate has a statistically significant impact on the financial market and the macroeconomy (Shibamoto, Takahashi , & Kamihigashi, 2021).

Sajjadur and al. (2023) investigated the relationship between unconventional monetary policy and stock market returns. They employed a structural VAR model using weekly data on the components of the Fed's balance sheet. The results showed that unconventional expansionary monetary policy is effective in stimulating the stock market, since it has positive and statistically significant effects on stock returns (Sajjadur & Apostolos, 2023).

In 2009, Boughrara conducted a study based on a similar model to assess and compare the transmission channels of monetary policy in Morocco and Tunisia. The main results of this research showed that neither the exchange rate channel nor the asset price channel are operational; both are inefficient in Morocco and even in Tunisia (Boughrara , 2009).

3. Research Methodology

Bank Al-Maghrib (BAM) manipulates morocco's monetary policy instruments in order to achieve its various objectives. Evaluating the transmission channels of monetary policy allows us to assess the effectiveness of these tools and enables the Central Bank to move towards a more effective operational framework. As a first response, based on the literature review, we propose the following hypotheses: Monetary policy has a positive impact on the Moroccan stock market. In other words, there is a significant correlation between the monetary policy instrument (interbank market rate) and the stock market (MASI).

H1: A significant correlation exists between the monetary policy instrument (interbank market rate) and the stock market (MASI).

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In order to assess the effectiveness of the Moroccan stock market channels, we will first select the variables to be studied in the first part. To this end, we will select variables that are representative of Morocco's monetary policy, including the instruments most commonly used by Bank Al-Maghrib. The study period will be a period in which the monetary authority frequently uses the selected tool. Then, we will introduce other variables that will be introduced in the transmission channel, which corresponds most of the particularities of the financial system and the Moroccan economy.
The first sub-section will present modeling methods that allow us to evaluate the transmission channels of monetary policy by integrating selected variables from an econometric point of view (second sub-section). The purpose of the latter is to justify the choice of using the VAR method, the representation of the model and the different testing and statistical techniques to be used.
The third sub-section will present the strategy for studying the stock price channel and the results of the empirical test of the VAR model to evaluate it.
The fourth sub-section will focus on the analysis and explanation of the evaluation results of the stock price channel in Morocco.

3.1. Research Variables

This sub-section is devoted to the selection of the different variables that will be included in the analysis of monetary transmission. While taking into account the specificities of monetary policy, the financial system and the economy of Morocco, as well as the variables that are the subject of the multi-criteria strategy of Bank Al-Maghrib.
The choice of the study period will be closely linked to the monetary policy instrument used in our model.
The asset price channel will allow us to study whether asset prices, represented by the MASI, are influenced by the monetary variables represented by the interbank market rate, the money supply and the consumer price index, and by the financial variable through the real effective exchange rate.
Using quarterly data from BAM, the High Commission for Planning (HCP), the IMF, the World Bank and the Casablanca Stock Exchange, we constructed a quarterly database covering the period from 2007 Q1 to 2017 Q4. The choice of a quarterly frequency is based on the fact that monetary policy decisions are taken quarterly following Bank Al-Maghrib's board meetings.
The first model will assess the impact of the interbank market rate on the MASI:
-Interbank market rate: Used as a proxy for monetary policy, the authors justify this choice by the fact that the policy rate does not change frequently and at the same time, they consider that the interbank rate is controlled by the policy rate.
-MASI (Moroccan All Shares Index): this is the global stock market index of the Casablanca Stock Exchange which is composed and calculated on the basis

of the free float of all listed shares. From 1999 to 2011, the MASI rose from 4,865.07 to 11,027.65, i.e. an increase of nearly 126.7% (Data source: Casablanca Stock Exchange).
The other variables of the model are:
- Money aggregate M3: We calculated the quarterly average from the monthly data published by Bank-Al-Maghrib.
- The consumer price index: It is calculated monthly and we have calculated its quarterly value from HCP data.
- Real effective exchange rate: We obtained the data from the International Monetary Fund.
We have chosen to integrate these variables into our model for evaluating transmission channels, taking into account the specificities of the Moroccan financial system and economy.

Table 1: variables of the model

Monetary variables	Overnight interbank market rate (TMI) Monetary aggregate (M3) Consumer Price Index (IPC)
Financial variables	Moroccan All Shares Index (MASI) Real Effective Exchange Rate (TCER)

Source: Authors

Logarithmic transformations of variables

Several notable studies on the transmission of monetary policy have employed the logarithmic transformation of specific variables. Examples of these studies include (Sims, 1992), (Christiano, Eichenbaum, & Evans, 1996), and (Leeper, Sims, Zha, Hall, & Bernanke, 1996).
We will transform the following variables into their logarithms: the MASI stock market index, the M3 money aggregate, the consumer price index (IPC), in order to alleviate the problem of the non-linearity of the heterogeneity of the orders of magnitude or the units of measurement of the variables used in an econometric model.
Before proceeding with the application of the VAR model, a series of tests to verify the reliability of the series used.

3.2. Descriptive statistics

Table 2: Descriptive Statistics

	LMASI	TMI	LM3	LIPC	TCER
MEAN	9.288926	2.976505	13.72340	4.708915	0.898544
MEDIAN	9.300594	3.128909	13.76941	4.706203	0.871198
MAXIMUN	9.572569	3.670878	14.04342	4.780243	1.010319
MINIMUM	9.054263	2.095576	13.24451	4.619402	0.835786
STD. DEV.	0.131581	0.423176	0.222485	0.042219	0.052517

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SKEWNESS	0.203480	-0.678199	-0.581364	-0.241087	0.681092
KURTOSIS	2.253213	2.202566	2.248214	2.252742	1.954398
JARQUE-BERA	1.326062	4.538816	3.514717	1.449957	5.406184
PROBABILITY	0.515287	0.103373	0.172500	0.484335	0.066998
SUM	408.7127	130.9662	603.8294	207.1922	39.53593
SUM SQ. DEV.	0.744485	7.700345	2.128472	0.076645	0.118593
OBSERVATIONS	44	44	44	44	44

Source: Authors

An examination of descriptive statistics indicates that the data for each variable exhibit a distribution that approximates normality in terms of skewness and kurtosis.

- **Skewness**: For the interbank market rate series, the money supply and the consumer price index, the distributions are right-shifted, whereas for the stock market index and the exchange rate, they are left shifted.
- **Kurtosis**: All series are flatter than normal.
- The ratio **Mean / Median** of each variable is close to 1.
- The **standard deviation** is relatively small in comparison to the mean, indicating a low coefficient of variation.
- **Normality**: All the variables follow the Normal distribution.
- **Stationarity**:

For ADF, the results are as follows:

Table 3: Table of results of the unit root test (ADF)

UNIT ROOT TEST RESULTS TABLE (ADF) Null Hypothesis: the variable has a unit root						
	At Level					
		LMASI	TMI	LM3	LIPC	TCER
With Constant	t-Statistics **Prob.**	-1.2398 **0.6485** n0	-0.4642 **0.8883** n0	-2.2878 **0.1804** n0	-1.4565 **0.5457** n0	-2.1446 **0.2290** n0
With Constant & Trend	t-Statistics **Prob.**	-1.0196 **0.9304** n0	-3.4541 **0.0575** *	-2.3314 **0.4088** n0	-3.5036 **0.0516** *	-1.6796 **0.7431** n0
Without Constant & Trend	-Statistics **Prob.**	0.3325 **0.7769** n0	-0.7993 **0.3639** n0	4.7708 **1.0000** n0	4.3438 **1.0000** n0	-3.3023 **0.0015** ***
	At First Difference					
		d(LMASI)	d(TMI)	d(LM3)	d(LIPC)	d(TCER)
With constant	t-Statistics **Prob.**	-4.6124 **0.0006** ***	-6.4383 **0.0000** ***	-6.7134 **0.0000** ***	-6.2890 **0.0000** ***	-5.6966 **0.0000** ***

With Constant & Trend	t-Statistics **Prob.**	-4.6792 **0.0027** ***	-6.4989 **0.0000** ***	-7.1036 **0.0000** ***	-6.3203 **0.0000** ***	-5.8493 **0.0001** ***
Without Constant & Trend	-Statistics **Prob.**	-4.6742 **0.0000** ***	-6.3792 **0.0000** ***	-4.7137 **0.0000** ***	-4.5838 **0.0000** ***	-4.9386 **0.0000** ***

Source: Authors

The results show that the series are stationary in the first difference, i.e., they're integrated of order 1, which we note I (1) +C.

- Determination of the optimal lag of the VAR model: In our study, the results show that the optimal order is 0. Since the VAR model cannot have 0 as an order of lag, we have estimated it with an order of 1, i.e. we are going to estimate an autoregressive model of order 1 VAR(1)

Table 4: Delay information criteria

LAG	LOGL	LR	FPE	AIC	SC	HQ
0	468.3739	NA*	5.97e-17*	-23.16869*	-22.95758*	-23.09236*
1	487.5440	32.58913	8.07e-17	-22.87720	-21.61054	-22.41921
2	503.3681	22.94500	1.36e-16	-22.41841	-20.09620	-21.57877
3	525.4777	26.53154	1.85e-16	-22.27389	-18.89613	-21.05260

Source: Authors

3.3. Research Model

In this study, we employed the vector autoregressive model (VAR), which is widely recognized as one of the most commonly utilized methods to assess the impact of monetary policy on stock prices. The VAR model, introduced by Christopher Sims in the early 1980s, is a statistical framework designed to capture the interrelationships among multiple time series variables.

The selection of the VAR model was primarily based on three factors: Firstly, it was chosen due to the absence of exogenous variables, as all variables were treated as endogenous, which can lead to more accurate outcomes. Secondly, VAR models permit a variable's value to depend on factors beyond its own lags or combinations of white noise terms. This feature enhances the model's flexibility and explanatory power. VARs are therefore more flexible than univariate models (Rifat, 2015). Lastly, VAR models are extensively employed as the predominant method for assessing the connection between monetary policy instruments and stock prices. Additionally, numerous researchers have employed VAR models to investigate the fundamental relationship between monetary policy and stock returns.

After determining and presenting the model variables, we gave an initial formulation in the mathematical form of the model, which can be written as follows:

$$MASI = f(TMI, M3, IPC, TCER)$$

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Model Specification

To estimate our model, it is necessary to specify it in an econometric form. The fundamental equation used for estimating the relationship in log-linear form is as follows:

Equation 1

$$DLMASIt = \alpha + \beta DTMIt + \gamma DLIPCt + \psi DLM3t + \varphi DTCERt + \xi t$$

MASI: Moroccan stock market index
TMI: Interbank market rate
IPC: Consumer Price Index
M3: Money supply
TCER: Real effective exchange rate
ξt: error term (iid)
t: time index
D: first degree of differentiation I (1) +C

4. Results and discussion

4.1. Estimation results

The results of this modeling allowed us to determine several relationships between the five variables studied, but we are interested in expressing the equation for the Moroccan stock market index (MASI) in terms of the other variables. The estimated equation is as follows:

Equation 2

$$\begin{aligned}\text{DLMASI} = {} & \text{C}(1,1) * \text{DLMASI}(-1) + \text{C}(1,2) * \text{DLMASI}(-2) + \text{C}(1,3) \\ & * \text{DTMI}(-1) + \text{C}(1,4) * \text{DTMI}(-2) + \text{C}(1,5) * \text{DLM3}(-1) \\ & + \text{C}(1,6) * \text{DLM3}(-2) + \text{C}(1,7) * \text{DLIPC}(-1) + \text{C}(1,8) \\ & * \text{DLIPC}(-2) + \text{C}(1,9) * \text{DTCER}(-1) + \text{C}(1,10) * \text{DTCER}(-2) \\ & + \text{C}(1,11)\end{aligned}$$

The results of this equation are as follows:

Table 5: Estimation results

OBSERVATIONS: 41			
R-SQUARED	0.274010	Mean dependent var	0.000180
ADJUSTED R-SQUARED	0.032013	S.D. dependent var	0.057700
S.E. OF REGRESSION	0.056769	Sum squared resid	0.096680
DURBIN-WATSON STAT	2.119592		

Source: Authors

These results reveal the absence of autocorrelation of the errors.

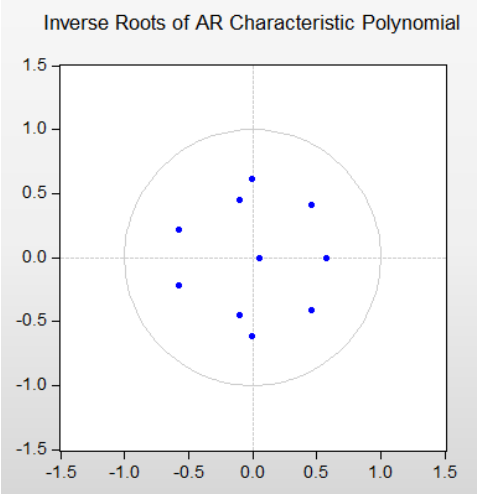
- Significance of the model: The results of the estimations that appear to reveal insignificant indicators. The coefficient of determination R-squared is insignificant insofar as the variables of the model explain 27% of the stock market. Thus, the coefficient of the F-statistic of the equation is not significant

because F-statistic of the equation is lower than the F-statistic of the table. So, we can say that our model is globally insignificant. In another way, we can say that the relationship between the variations of the stock market return and the variations of the interbank market rate, the money supply, the consumer price index and the real effective exchange rate is not too important for the Moroccan market.

- Model validation: In order to be able to interpret the various results from the VAR (1) model, it is necessary to test its econometric robustness. For this reason, several tests are used to study the validity of the VAR model. To do this, we will apply two tests: the stationarity test of the VAR model and the normality test.

- **The Stationarity Test of VAR (1):**

Figure 1: Stationarity test



Source: Authors

We notice that all the roots are inside the unit circle, so it follows that the VAR (1) model is stationary.

- **Jarque-Bera normality test**: The results of this test are represented in the following table:

Table 6: Jarque-Bera normality test

Component	Jarque-Bera	df	Prob.
1	0.513824	2	0.7734
2	1.149008	2	0.5630
3	132.5684	2	0.0000
4	0.098726	2	0.9518
5	0.024709	2	0.9877
Joint	134.3546	10	0.0000
*** Approximate p-values de not account for coefficient estimation**			

Source: Authors

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The results obtained from this test show that the variables of our model follow the normal distribution.

- **Error Autocorrelation Test**

Table 7: Error Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.535504	Prob. F (4.34)	0.2140
Obs*R-squared	6.579308	Prob. Chi-Square (4)	0.1599

Source: Authors

The results of this test show the absence of error autocorrelation.

- **Heteroscedasticity test**

Table 8: Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F- statistic	1.512481	Prob. F (4.38)	0.2180
Obs* R-squared	5.905726	Prob. Chi-Square (4)	0.2063
Scaled explained SS	4.404200	Prob. Chi-Square (4)	0.3541

Source: Authors

The results show that the errors are homoscedastic, they are constant over time.

- **Model specification**

Table 9: Model specification

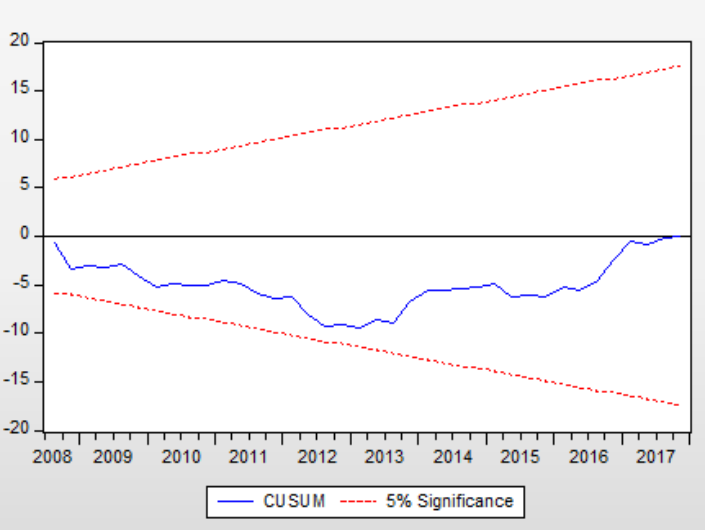
Ramsey RESET Test ***Equation : EQ01*** ***Specification: DLMASI C DTMI DLM3 DLIPC DTCER*** ***Omitted Variables: Squares of fitted values***			
	Value	Df	Probability
T-statistic	0.194658	37	0.8467
F-statistic	0.037892	(1.37)	0.8467
Likelihood ratio	0.044014	1	0.8338

Source: Authors

The results show that the model is linear.

- **Model stability**

Figure 2: Model stability



Source: Authors

We notice that the model studied, as well as the endogenous variable (DLMASI) are stable.

The various tests carried out show that the VAR (1) model is stationary and stable as well as a normal distribution of the variables. So we can say econometrically that our VAR (1) model is a valid model.

- **Cointegration Model**

Since all the series of the model are stationary in first difference I (1) +C, we can perform two cointegration tests: Trace and Maximum Eigenvalue.

Table 10: Cointegration Model

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	5	5	5	4	5
Max-Eig	1	1	1	1	1

***Critical values based on Osterwald-Lenum (1992)**

Information Criteria by Rank and Model

Data Trend	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend

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Log Likelihood by Rank (rows) and Model (columns)					
0	456.3150	456.3150	456.3997	456.3997	457.1946
1	473.4809	473.6609	473.7220	475.8722	476.5001
2	484.7018	486.6886	486.7495	489.5967	490.1558
3	493.7732	496.6517	496.6948	500.3400	500.8984
4	499.6852	505.4228	505.4498	509.4205	509.9457
5	502.2575	510.3232	510.3232	515.3857	515.3857
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	-21.03976	-21.03976	-20.79998	-20.79998	-20.59486
1	-21.38931	-21.34931	-21.15717	-21.21328	-21.04878
2	-21.44887*	-21.44822	-21.30485	-21.34618	-21.22711
3	-21.40357	-21.39764	-21.30219	-21.33366	-21.26334
4	-21.20415	-21.28892	-21.24145	-21.24002	-21.21686
5	-20.84183	-20.99138	-20.99138	-20.99443	-20.99443

Source: Authors

The Johansen Cointegration test shows the following:
- There are two Cointegration relationships according to the Akaike criterion which offers the most minimal value for No of CES equal to "2
- The minimum value of Akaike (i.e.: -21.44887) appearing on the column where the standard test characteristic is "No Intercept and No trend (None)", we deduce the form of our model to be estimated: it is a Cointegration equation without intercept and without trend.

On the basis of this information (especially the shape of the model), we will repeat the procedure by specifying the shape of our model.

Table 11: Cointegration test

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**5 Percent Critical Value**	**1 Percent Critical Value**
None**	0.567150	91.88507	59.46	66.52
At most 1**	0.421524	57.55318	39.89	45.58
At most 2**	0.357577	35.1151	24.31	29.75
At most 3**	0.250529	16.96868	12.53	16.31
At most 4**	0.117928	5.144758	3.84	6.51
Trace test indicate 5 cointegrating equation(s) at the 5% level				
Trace test indicate 4 cointegrating equation(s) at the 1% level				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**5 Percent Critical Value**	**1 Percent Critical Value**
None*	0.567150	34.33189	30.04	35.17
At most 1	0.421524	22.44167	23.80	28.82
At most 2*	0.357577	18.14283	17.89	22.99
At most 3*	0.250529	11.82392	11.44	15.69
At most 4*	0.117928	5.144758	3.84	6.51
Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level				
Max-eigenvalue test indicates no cointegration at the 1% level				

Source: Authors

- The results of the Cointegration test, taking into account the chosen VAR specification, show that there are only five Cointegration relationships between the variables considered at 5%. In fact, the calculated trace statistics are higher than the critical values at 5%. Moreover, there are four Cointegration relations at 1%.
- The Max-Eigen Statistic is lower than the critical values at 1%, which leads to accept the null hypothesis that the rank or the number of cointegrating vectors is zero. On the other hand, there is a cointegration relation at 5%.

We note the existence of cointegration between the variables. The vector autoregressive model (VAR) is the most suitable for our study.

- **Granger Causality Test**

Table 12: Granger Causality Test

Dependent variable: D(LMASI)

Excluded	Chi-sq	Df	Prob.
D(TMI)	3.943823	2	0.1392
D(LM3)	0.887790	2	0.6415
D(LIPC)	0.879711	2	0.6441
D(TCER)	0.670686	2	0.7151
All	6.70686	8	0.5683

Source: Authors

The results of this test show that the variables of the interbank market rate, the money supply, the consumer price index and the real effective exchange rate do not cause in the Granger sense the stock market presented by the MASI stock index.

- **Impulse response function**

The results of this test show us the following reactions:

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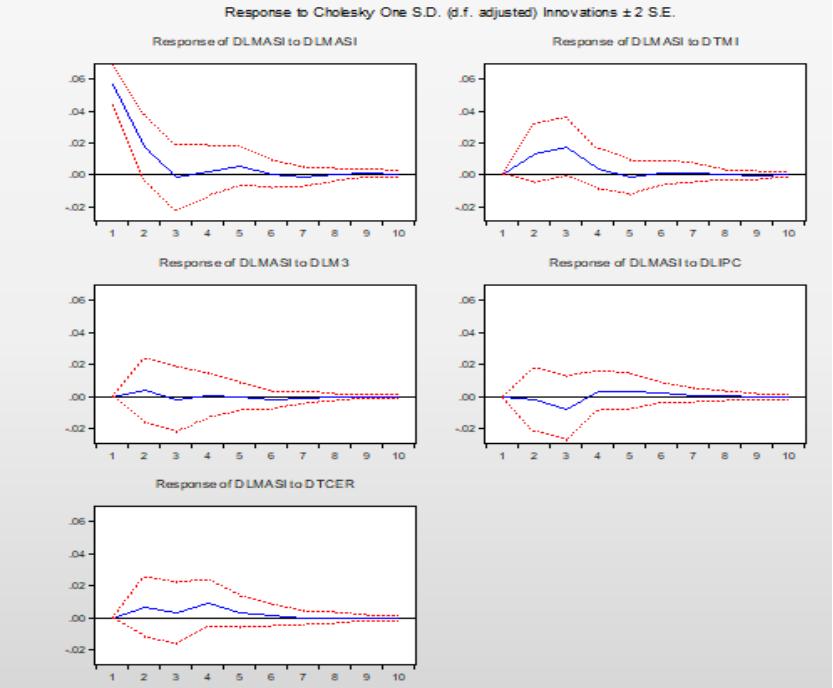
Figure 3: Impulse response of MASI to other variables



Source: Authors

- **Interpretation:**

A positive shock to the interbank market rate of 0.013 generates a very significant positive effect on the stock market (MASI) in the short run reaching a maximum of 0.018 during the third year. It then drops to -0.002 in the fifth year. Then reaching 0.002 at the end of the period. These results show a significant effect in all ten periods.
A positive shock of 0.02 in the monetary aggregate M3 has a non-significant effect on the stock market during the second period. Then there was a decrease of -0.002 during the third period, to stabilize in the fourth period.
A stable shock of the consumer price index during the first period, then it responds negatively from the third period reaching a minimum of -0.008, before rising to 0.003 and from the seventh period, it stabilizes.
A positive shock of 0.007 in the real effective exchange rate during the first period generates a positive effect on the stock market. And then a fall of 0.003 during the third period. Then an increase of 0.009 during the fourth period. And from the seventh period onwards, it stabilizes.

- **Variance Decomposition**

The following tables represent the results of the Cholesky variance decomposition test.

Table 13: Variance decomposition of the variable (DLMASI)

Period	S.E.	D(LMASI)	D(TMI)	D(LM3)	D(LIPC)	D(TCER)
1	0.056769	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.061416	93.51417	4.778921	0.404604	0.064694	1.237608
3	0.064492	84.84681	11.85211	0.473600	1.469091	1.358381
4	0.065356	82.74033	11.82773	0.466440	1.762115	3.203386
5	0.065784	82.29825	11.75105	0.460657	2.018144	3.471893
6	0.065891	82.03136	11.73519	0.544122	2.173010	3.516320
7	0.065915	82.01062	11.74929	0.549413	2.174849	3.515827
8	0.065919	82.00056	11.74904	0.550023	2.181771	3.518612
9	0.065925	81.99838	11.75181	0.550021	2.181639	3.518149
10	0.065927	81.99497	11.75312	0.550433	2.183012	3.518461
Cholesky Ordering: D(LMASI) D(TMI) D(LM3) D(LIPC) D(TCER)						

Source: Authors

As for the interbank market rate, it contributes an average of 11 percent of the variance of MASI between the third and tenth periods. This result shows that the interbank market rate does not play an important role in determining the variation of the financial market in Morocco.

For the consumer price index and the real exchange rate, they contribute an average of 2% and 3% respectively, whereas the monetary aggregate represents the smallest contribution (on average 0.5 percent).

The DLMASI variance has an impact on itself with an average of 84% during the study period.

It is concluded that the contribution of the interbank market rate in the variation of the stock market index is the largest compared to the other variables despite its small contribution.

For **the estimation without logarithmic transformation**, the results are the following:

Table 14: Granger Causality Test

Dependent variable: DMASI

Excluded	**Chi-sq**	**df**	**Prob.**
D(TMI)	4.777711	2	0.0917
D(LM3)	1.066232	2	0.5868
D(LIPC)	0.854614	2	0.6523
D(TCER)	0.726513	2	0.6954
All	7.876337	8	0.4456

Source: Authors

The results of **the Granger causality test** show that the variables of the interbank market rate, the money supply, the consumer price index and the real effective exchange rate do not cause, in the Granger sense, the stock market presented by the MASI stock market index.

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Table 15: Variance decomposition of the variable (DMASI)

Period	S.E.	DMASI	DTMI	DM3	DIPC	DTCER
1	632.8911	100.0000	0.000000	0.000000	0.000000	0.000000
2	700.9382	91.26211	6.509801	0.698884	0.089272	1.439933
3	739.4964	82.21492	14.30422	0.634858	1.469703	1.376294
4	747.9094	80.38077	14.18721	0.631756	1.770597	3.029666
5	753.6386	79.86043	14.08509	0.630993	2.043884	3.379596
6	754.5941	79.67204	14.06589	0.668392	2.174388	3.419283
7	754.9293	79.65711	14.07971	0.671350	2.175155	3.416676
8	754.9692	79.64995	14.07872	0.672606	2.180991	3.417735
9	755.0426	79.64649	14.08192	0.672495.	2.182021	3.417077
10	755.0642	79.6445	14.08250	0.672713	2.182720	3.417560
Cholesky Ordering: D(MASI) D(TMI) D(M3) D(IPC) D(TCER)						

Source: Authors

For **the variance decomposition test**, the DMASI variance has an impact on itself with an average of 79% during the period of the study. It is concluded that the contribution of the interbank market rate in the variation of the stock market index is the largest compared to the other variables despite its small contribution (14%).

4.2. Discussion

The study and analysis of the effect of monetary policy through the interbank market rate on the stock market presented by MASI, using the time series approach, has allowed us to draw a number of conclusions that are important:
-The variables in the model are not stationary. This led us to proceed to their stationarity by using differentiation.
-The test of determining the number of lags associated with the model (VAR) allowed us to retain a number of lags equal to one (1).
-The results of causality between variables indicate the non-existence of causality of exogenous variables "interbank market rate, money aggregate, consumer price index and real effective exchange rate" to the endogenous variable "MASI stock market index". This indicates that the Casablanca Stock Exchange and the monetary policy framework are independent of each other.
Through the VAR model, we have tried to examine the link between the stock market and the monetary policy framework for the Moroccan economy. Through this work, we have tried to determine whether monetary policy instruments and decisions can explain the performance of the stock market in the long run by conducting different tests. However, after conducting this study, the research reveals that there is no substantial association between monetary policy instruments and the stock market in Morocco.
The table below presents a comparison of our findings with previous studies.

Table 16: Comparison of our findings with other studies

Authors	Year	Results	Compatible Or incompatible results
Mukherjee and al.	1995	A positive correlation is observed among the variables, except for inflation and interest rates.	Incompatible results
Gilchrist and Leahy	2002	There is no reason to consider stock prices in determining the most effective monetary policy	Compatible results
Mansor H. Ibrahim	2003	The results revealed a positive correlation between the Malaysian stock market index and economic variables.	Incompatible results
Cassola and Marona	2006	They found that a permanent positive monetary shock would have a temporary positive impact on real stock prices	Incompatible results
Rahman and Uddin	2009	They found that there is no cointegration or causality between stock prices and exchange rates in various countries	Compatible results
Alam and Uddin	2009	The findings indicate a negative correlation between interest rates and stock returns, whereas a positive relationship is observed between money supply and stock returns.	Incompatible results
Banerjee and Adhikary	2009	The results indicate that changes in interest rates and exchange rates have a long-term impact on the stock market, while in the short term, the relationship between the exchange rate and the stock market is nearly independent.	Incompatible results (Long Run)
Boughrara	2009	The main results of this research showed that neither the exchange rate channel nor the asset price channel are operational; both are inefficient in Morocco and even in Tunisia	Compatible results
Myftari and Rossi	2010	There is a strong correlation between financial stability and monetary and macroeconomic stability	Incompatible results
Iddrisu, Harvey and Amidu	2017	The study found that the stock markets of the 12 African countries are positively affected simultaneously by their respective monetary policies through the interest rate channel	Incompatible results
Lütkepohl and Netšunajev	2018	Their results showed that monetary policy shocks lead to a sustained decline in real stock prices	Incompatible results
Sashikanta and al.	2019	The results of this study confirm the proposition that the transmission of monetary policy via the stock market is significant	Incompatible results
Edwin Prabu and al.	2020	They found heterogeneous effects of monetary policy announcements on sectoral	Incompatible results

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		stock indices, with policy surprises having a significant influence on a few sectors	
Shibamoto and al.	2021	The results showed a significant impact of Japanese monetary policy on the financial market from the 1980s onwards	Incompatible results
Sajjadur and al.	2023	The results showed that unconventional expansionary monetary policy is effective in stimulating the stock market, since it has positive and statistically significant effects on stock returns	Incompatible results

Source: Authors

A stock market that is shallow and small may be one of the reasons behind this, as the Casablanca Stock Exchange has only 73 companies listed in 2020.

5. Conclusion

During this work, we studied the efficiency of the stock price channel and the conduct of monetary policy for the case of the Moroccan economy. The results found proved the existence of a malfunction in the transmission mechanism of stock prices in Morocco. This invalidates our central hypothesis at the outset that there is a dependence between the Central Bank and the stock market.

In response to our research question, the first and second sections focused on the analysis of the various theoretical leads and empirical evidence on the effect of monetary policy on the stock market via the stock price channel. According to the studies found, the stock price channel in Morocco is not operational.

This analysis allowed us to identify the instruments and mechanism of stock price transmission which were empirically studied in the third section using VAR modeling. We evaluated the transmission of monetary policy via the asset price channel. This econometric evaluation was conducted using the results of the VAR model estimation, the impulse response function, the forecast error variance decomposition, and causality in the Granger sense.

Our results cover the study period between Q1 2007 and Q4 2017. We find that the equity price channel is not operational in Morocco, for the transmission phase of the interbank market rate to MASI.

Based on the empirical findings, no statistically significant correlation is observed between the monetary policy instruments. (Interbank market rate, M3 money aggregate, consumer price index, real effective exchange rate) and the stock market (MASI stock index) in Morocco.

In order to operationalize the stock price channel, Bank Al-Maghrib could put in place a monetary policy instrument that could both participate in the dynamics of the capital market and finance the Moroccan economy.

In order to make the stock market channel operational, Bank Al-Maghrib can develop a monetary policy tool that can both participate in the development of the capital market and stimulate the Moroccan economy.

The results of our research can be complemented by the use of other models (such as the SVAR model), which allows the introduction of restrictions on the instantaneous effects between the variables contained in the model, so that the SVAR model may be the most appropriate for this transmission channel structure.

In addition, due to the lack of long and sufficient statistical data sets, in particular the Real Estate Asset Price Index, these contributions that we were not able to make will further complement our work.

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