



Macroeconomics dynamics: exploring the impact of stock market development on economic growth in mali

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Abstract

Economic growth is often influenced by various factors, with stock market development playing a crucial role. This study investigates the relationship between the stock market development, specifically the Bourse Régionale des Valeurs Mobilières (BRVM), and economic growth in Mali. The BRVM serves eight West African countries, including Mali, and its development may impact regional economies. Utilizing monthly data from January 2009 to December 2020, this research examines the effects of BRVM Market Capitalization, BRVM Composite Index, Capital Flow, and Inflation on Mali's Gross Domestic Product (GDP). The study employs an Autoregressive Distributed Lag (ARDL) model and Vector Error Correction (VEC) model to analyze both short-run and long-run relationships. Findings suggest a significant long-run relationship between stock market development and economic growth in Mali, with inflation and capital flow having negative impacts, while market capitalization and the BRVM Composite Index show positive but less significant effects. The study contributes to understanding the macroeconomic dynamics within West African economies and the importance of stock market development in promoting economic growth.

Keywords Macroeconomics dynamics · Economic growth · Stock market development · Autoregressive distributed lag (ARDL)

JEL E01 · E02 · E20 · F43 · G12 · G15

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Introduction

Economic growth has been a central topic in economic discussions for decades. It is generally defined as an increase in the production of goods and services within an economy, typically measured by Gross Domestic Product (GDP). Numerous factors influence economic growth, with stock markets being a significant indicator of a country's economic health. Valderrama (2003) found that financial development contributes to economic growth, but the precise mechanisms and policies needed to promote growth remain inconclusive. Benhabib and Spiegel (2000) established that financial development positively impacts growth and investment, with indicators correlated to both total factor productivity growth and investment, but their correlations differ.

In African economies, stock markets are still evolving and often require increased efficiency to attract more investors and companies. Despite their size, their impact on African economies cannot be overlooked, and the Regional Securities Exchange (Bourse Régionale des Valeurs Mobilières—BRVM) is a notable example.

The BRVM serves as a regional exchange for eight West African countries, including the Republic of Mali. According to the World Bank (2024), Mali has a GDP growth rate of 3.5%, ranking 121st globally in terms of GDP (current US\$) and 24th out of 47 Sub-Saharan African countries. Despite being considered “mostly unfree” with an economic freedom score below the global average but above the regional average (Index of Economic Freedom, 2024), Mali's economy has shown resilience, maintaining slight growth amidst political and security challenges over the past decade.

Mali, along with Cote d'Ivoire, Senegal, Burkina Faso, Niger, Togo, Benin, and Guinea-Bissau, shares the BRVM. The exchange is dominated by companies from Cote d'Ivoire and Senegal, the region's strongest economies. Many economic sectors are listed but health and technology companies are not.

Currently, Mali has only one company listed in the BRVM's main compartment, the Bank of Africa Mali. Although this is a small presence among the 46 listed companies, various economic policies within the West African States Economic Community (ECOWAS) continue to promote economic integration and development (Ighobor 2024; Sustainable Stock Exchange Initiative 2023). Therefore, a regional economic integration is underway even though it still needs rooms for improvements.

The question of “Does the regional stock exchange development affect Mali's economy?” arises. This study investigates the existence of relationship between Mali's economy growth and the BRVM development. In this study, research and publication ethics were complied with.

Literature review

Studies on economic growth and stock market development are not scarce among financial economics research topics. While most of them were conducted on developed economies markets, some are of international dimensions, and others are based on developing economies. Market development effects on asset growth is more noticeable in advance economies (Titman et al. 2013). However, this effect is not related to trading expenses and corporate governance (Titman et al. 2013).

Other studies on the effect of stock market and banks on economic growth show that the former has more significant effect on economic growth than the latter (Arestis et al. 2001). It is worth reminding that banks are also strong players in the stock markets. Çiftçi et al. (2017) found similar results but stressed that credit market contribute more on the positive of stock market development on economic growth. Following Schumpeter's assertion (1911) that financial intermediaries' core activities promote long term economic growth, Drebensov et al. (1993) established there is strong correlation between financial development and economic growth, investment rates and capital efficiency.

Most studies on developed nations have determined a positive relationship between market development and growth; this result was confirmed by Pradhan (2018) from his research on G-20 countries. He further stressed the need for sustainable economic policies. Opposite results were found in Belgium by Tsaurai (2016) when he established the absence of long-term causality between stock market development and economic growth. However, Baral (2019) found a result in line with previous empirical studies in Nepal.

Conclusive studies have also been conducted on emerging economies. El-Wassal (2005) carried out a study on 40 emerging economies from 1980 to the year 2000. He found that economic growth, financial freedom policies and foreign portfolio investment are the primary causes of stock market growth. Similarly, studies are scarce in Sub-Saharan African countries; Enisan and Olufisayo (2009) analyzed the impact of market development to economic growth. Using a bound test and Vector Error Correlation Model, they found that stock market development cause economic growth in Egypt and South African. Their study further established that there is a two-directional Granger causal relationship between stock market development and economic growth in Cote d'Ivoire, Kenya, Morocco and Zimbabwe.

Furthermore, Adjasi and Biekpe (2006) conducted a similar study on 14 African nations. They found a positive impact on stock market development on economic growth in most upper-middle-income economies and in moderately capitalized markets. The study leads to the conclusion that more developed and capitalized economies in Africa are in better position to drive countries to economic growth. Alfonso and Reimers (2021) investigated on the relationship between stock markets and economic growth in African countries; they found that the introduction of stock market leads to a hump-shaped increased in GDP per capita; the effect peaks in the fifth year and becomes insignificant afterward. They stressed that ongoing market development and supportive policies are necessary for sustainable results. Different results were found

by Kagochi and Durmaz (2020). They conducted a study on the relationship between stock market development, human capital and economic growth on Sub-Saharan Africa. They found that human capital positively affects economic growth unlike stock market development. Similar research was carried out by Ali and Adahama (2023) on selected African economies with focus on market development, monetary policy and economic growth. They underscore that both market development and monetary policy have a positive effect on economic Algeria, Angola, Libya and Nigeria.

Yu and Sanchez (2012) found different causal relationship between stock market development and financial factors across different regions and income groups. Nazir and Gilani (2010), on their study on Pakistan stock markets, established that the size and market capitalization can strongly influence economic growth. Filer and Campos (2000) had found similar results but stressed that the effect can lead to currency appreciation.

In his comparative study between bank-based versus market-based financial systems, Tadesse (2002) observed that market-based systems are more effective in economies with developed financial sectors while bank-based systems have better performance in less developed financial environments. This indicates that countries' conditions determine the financial infrastructure.

In Mali, as in the rest of west Africa region, financial integration is enhanced by the West Africa Economic and Monetary Union (WAEMU) through the creation of a regional stock exchange: Bourse Regionale des Valeurs Mobilieres. El-Wassal (2005) further stressed that financial freedom policies and foreign portfolio investment play a crucial role in promoting stock market growth; he also determined that reducing entry barriers and enhancing market efficiency attract foreign investments.

The results of El Wassal's study also indicated that low country risk promotes stock market growth. Unlike country risk, high interest rate negatively affects stock market development (Vazakidis and Adamopoulos 2009). Levine and Zervos (1996) had indicated that, whilst there is a positive correlation between economic development and stock development, the correlation is but partial and not definitive. This may lead to the understanding that stock market development can be influenced by many factors; political stability, regulatory quality and the overall economic environment could all play important role.

Studies on the correlation between stock market development and economic development have not always showed a positive correlation, in reference to Tsaurai (2016) and Filer et al. (2000). This leads to the conclusion that there is need for tailored policy approaches. Some argued that the effectiveness of financial systems is context-based and that policies meant for advocating the market and financial architecture must be adapted to each country's specific conditions (Tadesse 2002).

Theoretical framework: economic growth vis-a-vis stock market development

Economic growth and stock market development have several frameworks under which they are linked, and which focus on the importance of financial system in the economic activities of a country.

Capital accumulation and resources allocation

Stock markets can drive foreign investments in the domestic economy's stock exchange. Following the endogenous growth theory of Romer (1990) and Lucas (1988), optimal allocation through the financial markets creates additional opportunities for capital accumulation and growth of effectiveness factors. For instance, companies can accumulate capital through stock exchanges and finance their activities, hence triggering and an economic growth. This mechanism agrees with Schumpeter's (1911) concept that states that stock markets and other intermediaries are engines of innovation and growth.

Liquidity and investment efficiency

Constant buying and selling securities are guaranteed in stock markets; this makes the market liquid enough diminish risk in long-term investments. Hence more capitals are outlaid to the market from investors of all forms (Levine 1991). Liquid markets enhance price discovery which reflects the values of firms in the market, and then resources can be mobilized to the most productive sectors. This is in line with the work of Levine and Zervos (1998), who showed that there is a correspondence of increased stock market liquidity with long-term economic growth.

Risk diversification and financial stability

Stock markets enable investors to hedge the risks associated with their placements. This is because of the risk-sharing mechanism that is inherent in the buying and selling of securities in stock markets. Developing economies' stock exchanges benefit more from this as they may often need international financial integration. In this way, stock markets help to attract foreign capital which in return helps the domestic economy grow (El-Wassal 2005).

Information efficiency and corporate governance

Stock markets have norms and standards; information transparency is one of them. Quoted firms must conform to the norms so that information asymmetry can be reduced amongst the actors of the markets. Consequently, better corporate governance is conducted to live up to investors and regulators' expectations, and eventually grow economic growth (Stiglitz 1985; Claessens and Laeven 2003).

Wealth effect and consumer spending

In countries where stock markets are essential to household wealth, their performance tends to affect consumer expenditure and aggregate demand. The wealth

effect, therefore, states that a growth in stock market prices will raise consumer confidence and encourage them to spend more, thus boosting the economy.

Regional integration and economic effects

Stock exchanges have also been a regional development stimulant in West African countries where economic integration is supported by structures like the BRVM. The establishment of regional stock exchanges encourages cross-border investments, economies of scale, and increase in the scope of economic activities by collecting domestic stock market resources from several countries. The common financial structure of the BRVM helps in enriching the market and drawing in international investors, which can result in wider economic advantages for all member states (El-Wassal 2005).

Data and methodology

In this section, data set, research methodology and empirical findings are presented.

Data set

This study looks possible relationships between economic growth and other macro-economic factors, notably Inflation, BRVM Market Capitalization, Capital Flow and BRVM Composite Index.

Gross Domestic Product (GDP)

The economic well-being of a nation or region is frequently evaluated using Gross Domestic Product (GDP), which quantifies the total market worth of all final products and services generated and provided within a designated timeframe by one or multiple countries. It represents the economic growth in this study.

Inflation

As a widely used metric for gauging economic spending, the Consumer Price Index (CPI) serves as a valuable tool. In the context of this particular investigation, the CPI was employed to assess inflation levels.

Market capitalization

The market capitalization of a publicly traded company represents the combined worth of all the common shares held by shareholders. This value is determined by multiplying the market price per common share by the total number of outstanding common shares.

Capital flows

These include all transactions recorded in the capital accounts, as well as the financial account of the balance of payments, such as foreign direct investments (FDI), portfolio investments, and other investments including loans and banking capital.

BRVM composite index

The BRVM Composite is a stock index calculated from the value of each stock on the BRVM. The BRVM Composite is a West African stock market index created with the base 100 on September 15, 1998. Monthly data from January 2009 to December 2020 were used to conduct this study. Data were collected from International Monetary Fund, World Bank and BRVM websites. Not all data were available in monthly data; those available in daily and annual frequencies, were converted into monthly frequencies (see Table 1).

It is worth noting that after the series normality test was first carried out, the log values of the variables were used to conduct the afterward-tests.

Research methodology

This study explores the existence of relationship (long or short) between GDP and other variables (BRVM Composite, Market Capitalization, Capital flow and Inflation). Eviews 10 was used to perform the analyses. The generic research model determined is the following:

$$GDP_{it} = \beta_0 + \beta_1 INFL_{it} + \beta_2 MKC_{it} + \beta_3 CPF_{it} + \beta_4 BRVM_{it} + \varepsilon_{it} \quad (1)$$

where: β_0 is Constant, β_1 is Inflation sensitivity monthly change, β_2 is Sensitivity of monthly change in market capitalization, β_3 is Sensitivity of monthly change in capital flow, β_4 is Sensitivity of monthly change in BRVM composite, ε_{it} is Error term.

Table 1 Macroeconomic factors used in analysis

Variable	Indicator	Measurement	Source	Variable type	
Economic growth	GDP	$\frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$	$\text{Log}\left(\frac{GDP_t}{GDP_{t-1}}\right)$	World Bank	Dependent
Inflation	Consumer Price Index	$\frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$	$\text{Log}\left(\frac{CPI_t}{CPI_{t-1}}\right)$	International Monetary Fund	Independent
Stock Market Index	BRVM Composite	$\frac{P_t - P_{t-1}}{P_{t-1}}$	$\text{Log}\left(\frac{P_t}{P_{t-1}}\right)$	BRVM	Independent
Market Capitalization	Market Capitalization	$\frac{MKC_t - MKC_{t-1}}{MKC_{t-1}}$	$\text{Log}\left(\frac{MKC_t}{MKC_{t-1}}\right)$	BRVM	Independent
Capital Flows	Capital Flow	$\frac{CPF_t - CPF_{t-1}}{CPF_{t-1}}$	$\text{Log}\left(\frac{CPF_t}{CPF_{t-1}}\right)$	World Bank	Independent

Source: Generated by the Authors

The series stationarity test was performed to detect a possible unit root; the test was run at both the Level and the First Difference. In the event where the series are $I(0)$ and $I(1)$, the Bound Test statistics and not the Johansen Test will be used for cointegration. The Bound Test is more appropriate because it is applicable on series at $I(0)$ and $I(1)$ and is more suitable for small and finite data samples. In the case of a Level relationship the variables, it will indicate that there are both short-run and long-run relationships between the variables. An Autoregressive Distributed Lag (ARDL) and a Vector Error Correction (VEC) models will be determined. The Error Correct model to be estimated is as follows:

$$\Delta \text{GDP}_T = \gamma_0 + \sum_{i=0}^p \gamma_1 \Delta \text{INFL}_{t-1} + \sum_{i=0}^p \varphi_1 \text{CPF}_{t-1} + \sum_{i=0}^p \varphi_2 \text{MKC}_{t-1} + \sum_{i=0}^p \varphi_3 \text{BRVM}_{t-1} + \mu \text{ECT}_{t-1} + u_i \quad (2)$$

γ_1 and φ_i stand for short-term coefficients, as for Δ , it represents the difference operator, μ stands for the order of delay, u_i represent the residuals and ECT_{t-1} signifies the term for error correction.

The ECT is expressed as follows:

$$\text{GDP}_{t-1} = \delta_1 \text{INFL}_{t-1} + \delta_2 \text{CPF}_{t-1} + \delta_3 \text{MKC}_{t-1} + \delta_4 \text{BRVM}_{t-1} + \varepsilon_1 \quad (3)$$

The long-term association between variables is displayed by ECT. The rate at which stock returns revert to equilibrium following a long-term divergence is measured by the μ coefficient. The system is considered balanced if the error correction coefficient is less than 1, and when it is negatively indicated, it suggests that, in the event of a deviation from balance, there is a movement towards equilibrium. In other words, according to Bozkurt (2007: 166), the mistake correction process functions.

Empirical findings

The result for the normality test is as follows (see Table 2).

The skewness' different values are all close to zero (0), which is the normal value for skewness for a normally distributed series. The Kurtosis, that displays the peak of flatness of the distribution of a series, has the value 3 as the normal Kurtosis value for a normally distributed series; the different series in this study have kurtosis values close to 3. Theses give enough idea that the series are normally distributed.

The Jarque–Bera statistics measure the difference the skewness the kurtosis of the variables. The null hypothesis states that the distribution is normal. At 1% significance level, it is safe to accept the null hypothesis. After this test, the logged values of the series were used to perform further tests.

Next, the series stationarity test was performed, and the relative results are as follow (see Table 3):

The stationarity test depicts that some variables (BRVM and Inflation) are stationary at Level ($I(0)$) and the others are $I(1)$. However, Capital Flow (CPF) is not $I(1)$. Even though CPF does not meet the strict $I(1)$ requirement, ARDL model is designed for datasets with a mix of $I(0)$ and $I(1)$ variables (Pesaran et al. 2001); as long as no variable is $I(2)$, the bounds test for cointegration in ARDL accommodates this scenario without requiring a pre-testing for the integration order for

Table 2 Normality test

Statistic	GDP	Capital flow	BRVM composite	Inflation change	Market cap
Mean	3.889118	2.975233	− 0.000436	− 0.337083	0.085132
Median	4.754179	3.111801	− 0.0014	− 0.041667	0.106027
Maximum	7.0847	4.971522	0.1526	3.56	0.353846
Minimum	− 1.2355	1.003936	− 0.1109	− 6.71	− 0.115385
Std. Dev	2.22547	0.899308	0.04465	2.358703	0.101483
Skewness	− 0.721538	− 0.190079	0.54978	− 0.565118	− 0.102936
Kurtosis	2.28213	2.454369	3.8283	2.692086	2.643682
Jarque–Bera	15.58682	2.653401	11.37067	8.233467	1.016077
Probability	0.000412	0.265351	0.003395	0.016298	0.601675
Sum	560.033	428.4336	− 0.0628	− 48.54	12.25895
Sum Sq. Dev	708.2384	115.6519	0.285092	795.5778	1.472739
Observations	144	144	144	144	144

Source: Generated by the Authors

each variable. In addition, the inclusion of CPF in the ARDL is based on the theoretical consideration that capital flow has effect on economic performance, especially in developing countries. Moreover, despite the ambiguity around CPF stationarity, the overall ARDL model appears to be a well specified and a robust model. However, its limitations and implications with respect to stationarity in CPF should be acknowledged. Nevertheless, considering the theoretical importance and the robustness of the results obtained by the current model, this analysis would still be valid and meaningful to the authors. The result for the Bound Test for cointegration is as displayed below (see Table 4).

The F-statistics value is superior to the level value ($I(0)$) value. This leads to the conclusion that there is enough significance (5%) to reject the null hypothesis of no long-run correlation between the variables. In other others, there is a long-run relationship between the variables.

Both the long and short run models need to be estimated; appropriate techniques are the ARDL and VEC models.

After running the ARDL models, it is necessary to determine the lag length for the afterward-analyses (see Table 5).

As the most decision criteria (including Akaike Information Criteria—AIC), the optimal lag length is 2.

The resulting ARDL model is determined below in Tables 6 and 7:

The results show that 98.58% of change in GDP is explained by the regressors. Inflation and Capital Flow, with enough significance level, have both negative effects on GDP. The results also show that Market Capitalization and BRVM Composite index have positive influence on GDP; however, these variables do not have their coefficients significant at 10%.

The long-run relationship results depict the following (see Tables 8, 9).

Table 3 Unit root test for stationarity (ADF)

Variable	Test type	t-Statistic	Prob	Significance
At level				
GDP	With constant	-2.4177	0.1387	Not significant
	With constant & trend	-2.3991	0.3785	Not significant
	Without constant & trend	-0.7523	0.3889	Not significant
BRVM	With constant	-10.9836	0	Significant***
	With constant & trend	-11.0415	0	Significant***
	Without constant & trend	0.03	0.6906	Not significant
CPF	With constant	-2.3408	0.1609	Not significant
	With constant & trend	-2.2295	0.469	Not significant
	Without constant & trend	-0.8969	0.3259	Not significant
INFL	With constant	-3.196	0.0223	Significant**
	With constant & trend	-3.3079	0.0691	Significant*
	Without constant & trend	-0.1454	0.6319	Not significant
MKC	With constant	-1.3025	0.6272	Not significant
	With constant & trend	-0.6541	0.9737	Not significant
	Without constant & trend	-0.633	0.4413	Not significant
At first difference				
d(GDP)	With constant	-5.1972	0	Significant***
	With constant & trend	-5.1808	0.0002	Significant***
	Without constant & trend	-5.2155	0	Significant***
d(BRVM)	With constant	-5.8691	0	Significant***
	With constant & trend	-5.8046	0	Significant***
	Without constant & trend	-5.8855	0	Significant***
d(CPF)	With constant	-1.3978	0.5816	Not significant
	With constant & trend	-1.321	0.8783	Not significant
	Without constant & trend	-1.3094	0.1753	Not significant
d(INFL)	With constant	-5.4405	0	Significant***
	With constant & trend	-5.3427	0.0001	Significant***
	Without constant & trend	-5.4638	0	Significant***
d(MKC)	With constant	-2.557	0.1047	Not significant
	With constant & trend	-2.5787	0.2908	Not significant
	Without constant & trend	-2.5649	0.0105	Significant**

() Significant at the 10%; () Significant at the 5%; () Significant at the 1%; (n0) Not Significant

Lag length determined by AIC

Probabilities based on MacKinnon (1996) one-sided p-values

Source: Generated by the Authors

Following the results, it can be noticed that there is an ECT value of -0.0225 . the negative sign indicates that shocks in the short run will be corrected in the long run at 10% significance level. In other words, the models will re-adjust itself in the long run after a shock in the long.

Table 4 Bound test for cointegration

Test statistic	Value	Significance level	I(0)	I(1)
F-statistic k = 4	2.993358	10%	2.2	3.09
		5%	2.56	3.49
		2.50%	2.88	3.87
		1%	3.29	4.37
Actual sample size	142	Finite sample: n = 80		
		10%	2.303	3.22
		5%	2.688	3.698
		1%	3.602	4.787

Null hypothesis: no levels relationship

Source: Generated by the Authors

Table 5 Lag selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−386.7358	NA	0.000219	5.760821	5.867904	5.804337
1	679.2595	2037.932	4.91E-11	−9.547933	−8.905436	−9.286839
2	990.2493	571.6725	7.33e-13*	−13.75367*	−12.57575*	−13.27499*
3	1010.195	35.19851	7.93E-13	−13.67934	−11.96601	−12.98309
4	1018.648	14.2961	1.02E-12	−13.43601	−11.18727	−12.52218
5	1053.145	55.80269*	8.96E-13	−13.57566	−10.7915	−12.44425
6	1065.952	19.77595	1.09E-12	−13.39635	−10.07678	−12.04736
7	1076.532	15.55843	1.38E-12	−13.18429	−9.329306	−11.61772
8	1082.882	8.872365	1.87E-12	−12.91004	−8.519637	−11.12589

Source: Generated by the Author

Table 6 ARDL model—short run relationship

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP (−1)	1.561969	0.069857	22.35951	0
GDP (−2)	−0.579662	0.072438	−8.002134	0
MKC	0.358929	0.261641	1.371839	0.1725
MKC (−1)	−0.547928	0.262494	−2.087395	0.0388
INFL	−0.034949	0.015853	−2.204529	0.0292
CPF	−1.689745	0.545708	−3.096425	0.0024
CPF (−1)	3.029527	1.041353	2.909222	0.0043
CPF (−2)	−1.403177	0.542557	−2.586228	0.0108
BRVM	0.051809	0.135294	0.382938	0.7024
BRVM (−1)	−0.118675	0.133456	−0.889243	0.3755
BRVM (−2)	0.274655	0.13552	2.02668	0.0447
C	0.091134	0.034009	2.679693	0.0083

Source: Generated by the Authors

Table 7 ARDL model summary

Statistic	Value
R-squared	0.986939
Adjusted R-squared	0.985834
S.E. of regression	0.025853
Sum squared resid	0.086886
Log likelihood	323.8383
F-statistic	893.0384
Prob(F-statistic)	0
Mean dependent var	0.743008
S.D. dependent var	0.217211
Akaike info criterion	−4.392089
Schwarz criterion	−4.142301
Hannan-Quinn criterion	−4.290585
Durbin-Watson stat	2.066688

Source: Generated by the Authors

Table 8 VEC model—long run relationship

Variable	Coefficient	Std. error	t-Statistic	Prob
D(GDP(-1))	0.743704	0.069961	10.63024	0
C	−0.000246	0.002341	−0.105022	0.9165
D(BRVM)	0.002949	0.1185	0.024884	0.9802
D(BRVM(-1))	−0.232597	0.115459	−2.014544	0.046
D(CPF)	−1.513056	0.593852	−2.547869	0.012
D(CPF(-1))	1.412658	0.593474	2.380318	0.0187
D(INFL)	0.048705	0.105546	0.461455	0.6452
D(INFL(-1))	−0.073573	0.099911	−0.73638	0.4628
D(MKC)	0.144769	0.261334	0.553963	0.5805
D(MKC(-1))	−0.570278	0.323002	−1.765552	0.0798
ECT(-1)	−0.022552	0.013302	−1.695332	0.0924

Source: Generated by the Authors

To complement the analysis of short and long-run relationships with the ARDL model, this research will also employ the Granger causality test as one of the supplementary tools to supplement the ARDL estimations. It should be underlined that in econometrics, the Granger causality test does not establish causality in any real strong sense but tells only the predictive power of one variable over another within the bounds of sample data. It gives the direction of probable causality from one variable to the other in an exploratory way, hence complementing the results obtained through the ARDL model. Results from the Granger causality test must therefore be interpreted cautiously and taken as indicative of rather than definitive of causality. The Granger Causality test was conducted, and the results are as depicted below. The null hypothesis for the test states that A does not Granger cause B.

Table 9 VEC model summary

Statistic	Value
R-squared	0.538897
Adjusted R-squared	0.503698
S.E. of regression	0.026673
Sum squared resid	0.093197
Log likelihood	318.8601
F-statistic	15.31015
Prob(F-statistic)	0
Mean dependent var	− 0.001108
S.D. dependent var	0.037861
Akaike info criterion	− 4.336057
Schwarz criterion	− 4.107085
Hannan-Quinn criterion	− 4.243012
Durbin-Watson stat	2.157282

Source: Generated by the Authors

According to Granger Causality, BRVM Composite Granger causes GDP with the inverse not being true. It simply says that a good performance of BRVM Composite index may have an effect on the Malian GDP and not the other way around. The results also indicated that there is a bidirectional relationship between Market Capitalization and GDP; Market Capitalization Granger causes GDP and at the same GDP Granger causes Market Capitalization.

Moreover, the causality test unveils that GDP causes Capital Flow and not the inverse. Indeed, a high GDP indicated a good economic health and that attracts investor, or foreign direct investment. It has also been determined that Inflation has a unidirectional effect on Market Capitalization (see Table 10).

Conclusion

This study explored the relationship between economic growth, as measured by GDP, and various macroeconomic variables, including Inflation, BRVM Market Capitalization, Capital Flow, and the BRVM Composite Index, using data from January 2009 to December 2020. Through rigorous analysis involving normality tests, stationarity tests, the ARDL model, VEC model, and Granger causality tests, several significant findings emerged.

The results indicate that inflation and capital flow negatively impact GDP, whereas market capitalization and the BRVM Composite Index positively influence GDP, though their coefficients are not always significant at the 10% level. The long-run relationship analysis revealed that shocks in the short run are corrected in the long run, indicating the models’ tendency to readjust towards equilibrium over time (see Table 10).

The Granger causality test showed that the BRVM Composite Index influences GDP without the reverse being true, suggesting that the performance of

Table 10 Granger causality test

Null hypothesis	Prob	Decision
BRVM does not Granger Cause GDP	0.0311	Reject
GDP does not Granger Cause BRVM	0.7219	Accept
CPF does not Granger Cause GDP	0.5458	Accept
GDP does not Granger Cause CPF	0.0057	Reject
INFL does not Granger Cause GDP	0.572	Accept
GDP does not Granger Cause INFL	0.6759	Accept
MKC does not Granger Cause GDP	0.0562	Reject
GDP does not Granger Cause MKC	0.0001	Reject
CPF does not Granger Cause BRVM	0.0145	Reject
BRVM does not Granger Cause CPF	0.6218	Accept
INFL does not Granger Cause BRVM	0.0671	Reject
BRVM does not Granger Cause INFL	0.8803	Accept
MKC does not Granger Cause BRVM	0.129	Accept
BRVM does not Granger Cause MKC	0.0411	Reject
INFL does not Granger Cause CPF	0.1461	Accept
CPF does not Granger Cause INFL	0.9175	Accept
MKC does not Granger Cause CPF	0.7289	Accept
CPF does not Granger Cause MKC	0.0893	Reject
MKC does not Granger Cause INFL	0.8653	Accept
INFL does not Granger Cause MKC	0.0558	Reject

Source: Generated by the Authors

the BRVM Composite Index can affect Mali's GDP. Additionally, a bidirectional relationship between market capitalization and GDP was identified, indicating mutual causality. GDP was also found to influence capital flow, underscoring the role of economic health in attracting foreign investments. Furthermore, inflation was shown to affect market capitalization unidirectionally.

Based on these findings, several recommendations can be made for policy-makers in Mali. To stimulate economic growth, it is essential to control inflation through effective monetary policies. Enhancing the performance and attractiveness of the BRVM Composite Index could positively influence GDP; these will call for a regional effort from all the WAEMU countries. Encouraging investments and improving market capitalization can create a virtuous cycle of growth. Additionally, fostering a stable and conducive economic environment is crucial for attracting capital flows and sustaining long-term economic health.

Overall, this study underscores the interconnectedness of macroeconomic variables and their collective impact on economic growth, offering valuable insights for strategic economic planning in Mali.

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Availability of data and materials The data of this study were collected from different websites notably those of the World Bank, the IMF and the BRVM. The datasets are available.

Declarations

Conflict of interest The author has no conflicts of interest to declare.

Ethical approval This research does not involve human participants, their data, or animals. Therefore, no ethical approval was required. All procedures and methods used in the study comply with the relevant institutional and international research guidelines and standards.

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