The macroeconomic effects of credit supply in Algeria: Evidence from a Restricted VAR analysis

Rym AMMARI [1, *]

[1]LEPEM laboratory, Faculty of Economic, Commercial and Management Sciences, Kasdi Merbah University, Ouargla / Algérie

Received: 13/02/2020 ; **Revised:** 20/02/2020 ; **Accepted:** 20/06/2020

Summary: This paper reports evidence of credit supply impact on macroeconomic variables in Algeria. Using a restricted vector auto-regression model as well as employing Granger causality tests, impulse response functions and variance decomposition analysis, we examine the link between credit supply and some standard macroeconomic aggregates over 2001:1Q-2017:4Q period in Algeria. The main findings of the study reveal the relative ability of credit supply to explain the circumstantial fluctuations in the economic variables especially on labor rate, consumer price index and gross fixed capital formation.

Keywords: Credit supply; Macro-econometric; Restricted Vector Auto-Regression; Modeling.
Jel Classification Codes : E510 ; C500.

I- Introduction :

The financial sector has become one of the important and influencing sectors in modern economy, and contributes to the formation of the added value to the economy. But this role differs from one country to another according to the extent and sophistication of the banking sector, its efficiency, and the depth of the link between it and the real economy. Therefore, the majority of developing countries, including Algeria, depend directly on the banking system for financing development and providing the necessary liquidity for various economic activities**.**

Quite recently, considerable attention has been paid to understand the relative role of credit supply, which is quite important as it has different implications for macroeconomic conditions. Moreover, in most cases, change in credit volume affects economic activity, but the question remains about the degree and the effectiveness of such effects.

This research paper is addressing the problematic of the contribution of the banking system in economic growth, where it will trace credit supply effects on macroeconomic variables in the Algerian economy. The main hypothesis of this study is that the credit supply affects the macroeconomic variables in varying degrees in Algeria.

The main objective of this study is to investigate the effect of credit supply on: growth in real GDP, consumer price index, labor rate, gross fixed capital formation and the coverage rate, in Algeria from 2001:Q1 to 2017:Q4, in order to evaluate the interaction between these indicators of the macro-economy and the credit supply. For this purpose, we use the Granger causality tests, impulse response functions and variance decomposition analysis based on a restricted vector auto-regression model (RVAR).

* Corresponding author, e-mail: ammari.rym@univ-ouargla.dz

The organization of this study is as follows. This section is dedicated to present the pioneering theoretical contributions in this topic, and to give a review of related literature. The next section provides a brief discussion of the methodology. Section 3 reports the empirical results, and the conclusion and recommendations are presented in Section 4.

I.1. Pioneering theoretical issues:

The issue of financial intermediation and its role in economic growth occupies an important place in contemporary economic development thought. Bagehot (1873) was the first to link finance to growth through his book "A Description of the Money Market", through which he argued that the financial system played a crucial role in 18th century England's industrialization through its effect on facilitating capital mobilization. Bagehot (1873) considered that the success of the economic development in England was due to the superiority of the British financial market, which had relative ease in mobilizing savings to finance various investments in the long run. So the opportunities for access to funding would have been decisive for the establishment and the development of new technologies in England. Consequently, Bagehot linked economic underdevelopment to the impossibility resource mobilization, characteristic of an atrophied or almost nonexistent financial system[1].

Moreover, Schumpeter (1911) argued that financial services, especially bank loans, were essential for growth economic insofar as they improve productivity by encouraging technological innovation. Besides, the banker makes it possible to identify the entrepreneurs who have the best chances of succeeding in innovation procedure. For Schumpeter (1911), financial development stimulates growth through the efficient allocation of resources. However, it's necessary to note that in Schumpeter's approach, the emphasis is not on the process of mobilization of savings but rather on the granting of credit. The bank finances the innovative entrepreneur by monetary creation (in case savings are insufficient) without ensuring that the existence of demand in the face of supply and without being able to assess the risk linked to an entrepreneur's innovation activity[2]. Thus, the idea of creative destruction by innovations and the notion that bank credit is a decisive prerequisite for pioneering entrepreneurs to finance innovational investment activities are key pillars of Schumpeter's Theory of Economic Development.

Furthermore, Hahn (1920) was concerned with the effects of credit creation and credit extension on production. He shares with Schumpeter the view that the main function of credit is the financing of economic development. He was convinced "that bank credit has the importance of a stimulus of the conjuncture"[3]. With his Economic Theory of Bank Credit, Hahn (1920) wanted to overcome the orthodox view that every credit has to be financed by means of savings deposited by the banks. According to his revolutionary view the formation of deposits is not the cause but the effect of the granting of credit by the banks[4].

Following these premises favorable to the financial sector, Keynes (1936) offers a theory of development different from that of Bagehot (1873) and Schumpeter (1911), focusing on the determining role of investment in overall production and employment. Also, Keynes (1936) in his analysis of the general theory, assumed that there is an organized and an efficient market for money and supposed an important role in the balance of the financial sector and that of the money market in the general equilibrium of the economy, as the absence of financial instruments and institutions will limit the conversion of savings into investments, which finds its negative impact in the form of a decrease in the growth rate of income and output[5].

I. 2. An overview of related literature:

The interactions between the real and the financial spheres of the economy and their role in cyclical fluctuations have caught the attention of economists for a very long time, as soon as they wanted to better understand the nature of economic cycles. However, until the 2007-2009 crisis, the usual macroeconomic modeling has largely neglected these interactions. Things have changed

considerably since then. The list of scientific publications offering different ways of "modeling" the interactions between financial and real economy spheres is growing massively.

Accordingly, empirical macro-econometric studies focus on the identification of credit-supply shocks and the measurement of the effects on the real economy of such shocks. Recent studies include Bassett et al. (2010), Sharif (2010), Jacobs & Rayner (2012), Korkomaz (2015), Ananzeh (2016), and Gambetti & Musso (2017).

Bassett et al. (2010)[6] use the Federal Reserve's quarterly Senior Loan Officer Opinion Survey to create a quarterly measure of credit supply shock. They include this measure as an exogenous variable in a VAR-X model with real GDP growth, inflation, growth in bank lending capacity, a credit spread and the federal funds rate as endogenous variables. Their analysis shows significant economic effects of supply shocks to changes in lending standards, as it was found that an increase of one standard deviation in tightening lending standards would lead to a decrease in real GDP by 0.4% in the year immediately following the shock. They also find that the estimated semi-elasticity of loan demand more than doubles in size, to -1.4, when using lending shocks series as an independent variable in a regression of loan quantities on loan spreads.

Sharif (2010)[7] examines the impact of bank lending supply fluctuations on economic activity in several developed and developing countries, (Argentina, Brazil, Venezuela, Indonesia, India, Malaysia, Thailand, Australia, New Zealand, Belgium, France, Italy, Germany, Spain, UK, Japan, Turkey, South Africa and the USA,). The study employed aggregate monthly data obtained from the IFS (International Financial Statistics), OECD (Organization for Economic Cooperation and Development) and Central banks websites of the relevant countries in question, where two variables were used bank loans and gross domestic product (GDP) to express economic activity, taking into account three other macroeconomic shocks (bank loans demand shock, inflation shock, and policy shock). Using unrestricted vector auto-regression models, she finds that bank loan supply fluctuations are responsible for disturbances in GDP in its sample of countries.

As reported by Jacobs & Rayner (2012)[8], Historical experience has shown that disruptions in credit markets can have a material impact on activity and inflation, but according to them, it is hard to measure such effects owing to the difficulty in isolating credit supply shocks. Based on a structural VAR model incorporating a survey data to identify the impact of credit supply shocks in Australia over the past three decades, they found that one standard deviation shock to credit supply is estimated to lower GDP by nearly ⅓ per cent after one year and business credit by almost 1 per cent after two and a half years. Furthermore, they identify the existence of a financial accelerator mechanism in the Australian economy.

Korkomaz (2015)[9] attempts to identify the potential bank credit effect on macro-variables economic growth (GDP) and inflation, for 10 randomly-selected European countries (Spain, Finland, France, Germany, Greece, Hungary, Italy, Poland, Turkey and United Kingdom), using annual data set 2006-2012. Panel data analysis was performed, and as a result of the conducted analysis, it was proved that domestic credits created by the banking sector for 10 European countries did not affect inflation but did affect economic growth.

Ananzeh (2016)[10] examines the relationship between bank credit and economic growth at different sectors (agriculture, industry, construction, and tourism), covering the Jordan market, which is one of the very important markets in the middle east for a long period span from 1993 to 2014 at quarterly base. Using two different methodologies vector error correction model (VECM) and granger causality test, the analysis results point out that the efficiency of the bank credit facilities in a major economic sectors has an important role in the Jordanian economic growth, and shows the needs to enhance the role of financial sector for different economic sectors by adopting more appropriate macroeconomic policies.

Gambetti & Musso (2017)[11] estimate time-varying parameter vector auto-regression models with stochastic volatility for the Euro Area, the United Kingdom and the United States, on the basis of a quarterly data set 1980-2011 comprising the following 5 variables: real GDP, a consumer price

index, non-financial private sector loan volumes, a composite lending rate and a reference short-term interest rate. The main results of their empirical analysis suggest clearly that loan supply shocks have a significant effect on economic activity, inflation and credit markets in all three economic areas, although some differences across geographic areas and changes over time can be uncovered. Moreover, it appears that the contribution of loan supply shocks was particularly important during the most recent recession in all three economic areas considered.

Depending upon the outcomes of the previous literature review, and at a practical level, our research contributes to the existing literature by providing evidence from Algerian data about the real effects of credit supply on economic activity.

II– Methods and Materials:

We relied on quarterly time-series data that spanned the period (2001:Q1-2017:Q4), which corresponds to 68 observations. The data are derived from the basis of statistical data of the National Office of Statistics and the bank of Algeria.

The restricted vector auto-regression (RVAR) model will be used in this study to explore the macroeconomic significance of credit supply. Our model consists of five other variables as well as the credit supply (CR), which are standard to macroeconomic analysis. They are presented as follow:

- **GDP growth (GDPG):** It measures the real economic growth as it relates to the gross domestic product (GDP) from one period to another, and it is expressed as a percentage that shows the rate of change in GDP, from one quarter to the next.
- **Consumer price index (CPI):** It is a measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food, and medical care. The CPI is one of the most frequently used statistics for identifying periods of inflation or deflation.
- **Labor force rate (L):** It is a measure of an economy's active workforce, and it represents the sum of all workers who are employed or actively seeking employment divided by the total non-institutionalized, civilian working-age population.
- **Gross fixed capital formation (GFCF):** It is essentially net investment, and it is a component of the Expenditure method of calculating GDP. The GFCF measures the net increase in fixed capital, and it includes spending on land improvements; plant; machinery; and equipment purchases; the construction of roads; railways; private residential dwellings; and commercial and industrial buildings.
- **Coverage ratio (COV):** It measures the relationship between the value of imports and the value of exports, and we obtained it by dividing export by import and multiplying the result by 100. Therefore, it is an indicator of economic independence.

To estimate our model, it is necessary to specify it under an econometric form:

$$A_0 Y_t = A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \varepsilon_t$$

Where Y_t is the vector of the variables described above:

$$Y_t = [\, CR;\ GDPG;\ CPI;\ L;\ GFCF;\ COV]$$

We impose the constraint that none of the macroeconomic variables has an impact on the credit supply variable. We need to impose restriction by putting zeros in rows of the lags matrix where it corresponds to the credit supply variable and we want the macroeconomic variables to have no effect upon it. Eviews 10 is very flexible when handling restrictions of some of the VAR coefficients to specific values, including zero[12].

III- Results and discussion :

1. Unit root test results

Firstly, we will use econometrics methods which are used in the literatures to test the

independence of all-time series.

Studying stationary allows determining the integration order of each series, for this aim we apply the Phillips-Perron tests to determine whether the time series data are stationary at levels or first difference. According to recent literature, panel-based unit root tests are more powerful than those based on individual time series. In this article, we apply the tests of PP Fisher Chi-Square test and PP Choi Z-stat test.

The summarized results from the unit root tests are reported in Table 1. The results clearly indicate that all tests fail to reject the null unit root hypothesis (the group series has a unit root) of non-stationary group series (CR, L, GFCF, GDPG, CPI, COV) at level, because the *p*-values of the Phillips-Perron statistics is greater than 0.05. The unit root should be removed by differentiating to correct the non-stationary.

Though, the steady state of all the variables has not been established in similar order. The test results indicate the presence of first-order integration for all variables except the GDPG series' which is integrated of order 0. Thus, there is no likelihood of cointegration among them.

2. The choice of the optimal number of lags:

Selecting the number of lags « P » is based on the minimization of the two information criteria: Akaike Information Criterion (AIC) and/or Schwarz Information Criterion (SIC).

Adopting the parsimony principle, which consists of choosing $P_{OPTIMAL}$= min {AIC, SIC}, leads to retain: P=5 lags (Table 2.), so to have uncorrelated residuals (white noise). The results of the estimation output are reported in Table 3.

3. Diagnostic Checks:

The RVAR model was subjected to rigorous diagnostic tests. Diagnostic checks are crucial in this analysis because if there is a problem in the residuals from the estimation of the model, it will be an indication that the model is not efficient, such that parameter estimates from such a model may be biased.

The RVAR was tested for AR Roots test and serial correlation and the results are indicated in Figure 1. The AR Roots Graph reports the inverse roots of the characteristic AR polynomial. The estimated RVAR is stable (stationary) if all roots have modulus less than one and lie inside the unit circle. If the RVAR is not stable, certain results, such as impulse response, are not valid. Figure 1. shows that all roots lie inside the unit circle, which is an indication that the RVAR is stable.

Heteroskedasticity refers to the circumstance in which the variability of a variable is unequal across the range of values of a second variable that predicts it. The diagnostic test results are presented in Table 4., which assist in checking for Heteroskedasticity. It shows that the *p*-value of the Chi-sq stat (0.2946) is greater than 0.05, therefore the null hypothesis is accepted that the error variance is constant (Homoscedasticity).

4. Granger Causality Tests Results

The Granger causality test based on the RVAR is used to determine the short and long run causal relationships among the variables.

To reject H_0 at 5% significance level (threshold value), probability value (*p*-value) must be less than or equal to 0.05 (i.e. *p*-value $\leq$ 0.05). Table 5. reports the result obtained from the causality test. In summary, we can conclude that CR variable causes, in the sense of Granger, the variables L, GFCF and CPI.

5. Impulse Response Functions (IRF) Test Results

Impulse response functions (IRF) is used to examine the dynamic behavior of the times series over 10-year forecast horizons. This study used the generalized impulse response functions

(GIRF).

Figure 2. shows that D(L) responds positively to a shock to D(CR) in the first period (0.013965), then the effect dies down from the 2nd period to the 5th period and grows positively again, but hit negatively one more time (-0.341542) at the end of the period. Besides, D(GFCF) is affected positively in the first period (34103.54) then decrease in spaced periods, the second period (-13467.99), the 5th period (-31236.35) and at the end of period (-70.48143). Moreover, when there is a shock to D(CR), GDPG will respond negatively in the 2nd, 4th and 9th periods, (-0.084328), (-0.029093) and (-0.318671) respectively, and positively for the rest of the periods. Furthermore, D(CPI) responds negatively to a shock to D(CR) in the first three periods, also the 5th, 8th and at the end of the period. Lastly, when there is a shock to D(CR), the response of D(COV) is negative in the first period, the 3rd, the 6th and the last three periods.

6. Variance Decomposition (VD) Analysis Results

The variance decompositions (VD) for 1-year to 10-year forecast horizons indicate the amount of information each variable contributes to the other variables in the RVAR. The results are as follow:

- The variance of the forecast error of D(L) is due at 29.2% on average to its own innovations, 19.1% to D(GFCF), 3.1% to GDPG, 7% to D(CPI), 1.2% to D(COV) and 40.3% to D(CR). Similarly, as for the causality test, this result shows fluctuations of labor rate are influenced by the credit supply.
- The variance of the forecast error of D(GFCF) is due at 75% on average to its own innovations, 2.7% to D(L), 2.1% to GDPG, 3.8% to D(CPI), 2.7% to D(COV) and 13.6% to D(CR).
- The variance of the forecast error of GDPG is due at 52.8% on average to its own innovations, 8.7% to D(L), 7.8% to D(GFCF), 13.3% to D(CPI), 6.8% to D(COV) and 10.5% to D(CR).
- The variance of the forecast error of D(CPI) is due at 34.6% on average to its own innovations, 5.2% to D(L), 25% to D(GFCF), 6.2% to GDPG, 4.2% to D(COV) and 24.7% to D(CR). It confirms the result obtained from the causality test.
- The variance of the forecast error of D(COV) is due at 30% on average to its own innovations, 6.6% to D(L), 33.4% to D(GFCF), 2.3% to D(CPI), 14.2% to GDPG and 13.4% to D(CR). It confirms the result obtained from the impulse responses analysis.

IV- Conclusion:

The growing importance of banks in the modern financial system and the current crisis has demonstrated that the role of financial intermediation cannot be overlooked, and we need to model the supply of credit to understand business cycle fluctuations better.

In this study, we adopted a restricted vector auto-regression model to investigate the relation between credit supply and different macroeconomic variables, and we have employed different advanced methodologies, as Granger causality test, impulse response functions and variance decomposition, using quarterly data for the period 2001-2017 in Algeria context.

The Granger causality test concludes for a causal relationship going from credit supply to labor force rate, gross fixed capital formation and consumer price index in Algerian economy.

In addition, the findings from the impulse functions response and the variance decomposition analysis suggest that there is a relative effect of credit supply on GDP growth and the coverage ratio in Algerian context.

Overall, the results provide strong evidence that credit supply influences the labor market, inflation and investment in Algeria. Our proposal based on the results of the paper is that further studies must be done in the future in the same contest, with further macroeconomic indicators such as non-hydrocarbon GDP.

- Appendices:

Table (1) : Unit root test results

Model	Method	PP Test (Group Series) (CR, L, GFCF, GDPG, CPI, COV)	
		Level	**Difference**
Individual intercept	**Fisher Chi-square**	13.9790 (0.3020)*	208.041 (0.0000)*
	Choi Z-stat	4.75977 (1.0000)*	-13.0153 (0.0000)*
Individual intercept and trend	**Fisher Chi-square**	15.9987 (0.1913)*	162.849 (0.0000)*
	Choi Z-stat	0.35061 (0.6371)*	-11.3454 (0.0000)*
None	**Fisher Chi-square**	8.54587 (0.7412)*	411.803 (0.0000)*
	Choi Z-stat	- NA	-16.3753 (0.0000)*

* *p*-value

The Source: made by the author

Table (2) : The choice of the optimal number of lags

	P=0	P=1	P=2	P=3	P=4	P=5
AIC (p)	55.35733	55.16169	55.61660	55.53161	54.90830	54.64724*
SIC (p)	55.56318*	56.60265	58.29267	59.44280	60.05460	61.02864

* *indicates lag order selected by the criterion*

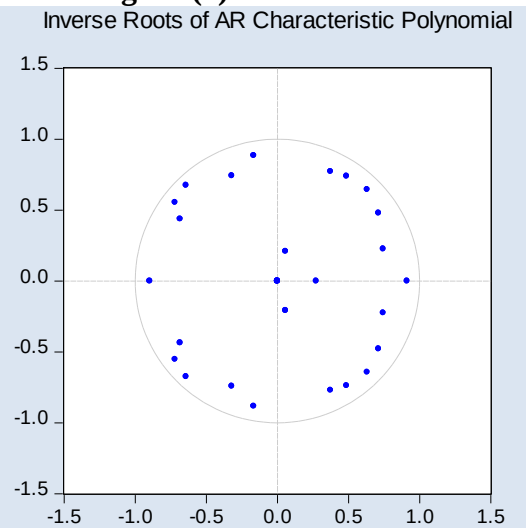
The Source: made by the author

Table (3) : Vector Auto-regression Estimates (with restrictions) output

	D(L)	D(GFCF)	GDPG	D(CPI)	D(COV)	D(CR)
R^2	0.796557	0.483257	0.721540	0.560476	0.492268	0.628465
$\bar{R}^2$	0.599677	-0.016818	0.452062	0.135130	0.000914	0.268915
S.E. of regression	0.403706	46987.63	1.428178	1.636515	18.81244	107.8879
DW	2.126954	2.040426	2.210312	2.126516	2.031808	2.162920
S.D. dependent var	0.638058	46597.43	1.929375	1.759723	18.82104	126.1795

The Source: made by the author

Figure (1) : Inverse Roots



The Source: Eviews output

Table (4) : VAR Residual Heteroskedasticity

VAR Residual Heteroskedasticity Tests (Levels and Squares)
Sample: 2001Q1 2017Q4
Included observations: 62

Joint test:

Chi-sq	df	Prob.
1286.624	1260	0.2946

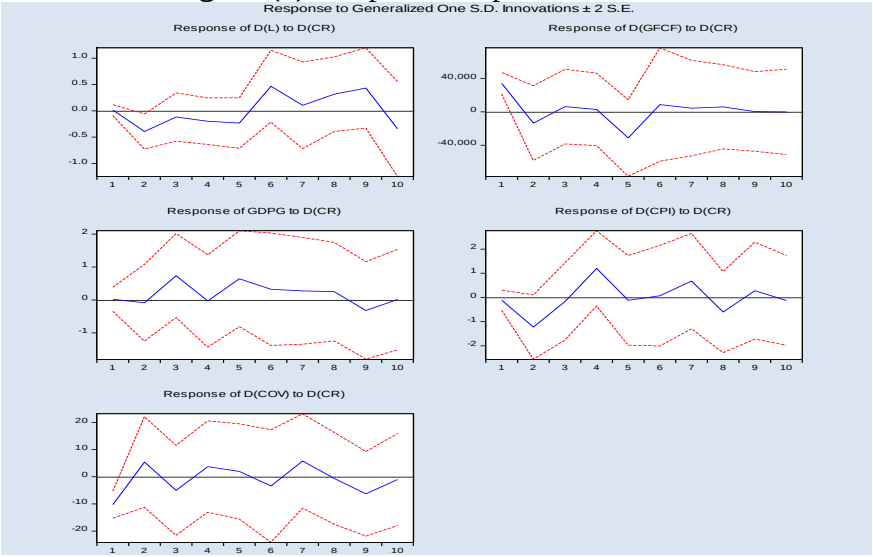
The Source: Eviews output

Table (5) : Granger Causality

Causality	F-Calculated	P- value	Decision
CR → GDPG	4.324100	0.5038	Accept H_0
CR → CPI	11.84565	0.0370	Reject H_0
CR → L	22.55395	0.0004	Reject H_0
CR → GFCF	15.03866	0.0102	Reject H_0
CR → COV	4.193207	0.5219	Accept H_0

The Source: made by the author

Figure (2) : Impulse Response Functions



The Source: Eviews output

Referrals and references:

1. W. Bagehot (1873), **Lombard Street: a Description of the Money Market**, London: Henry S. King & Company 65 Cornhill & 12 Paternoster Row.

2. J. A. Schumpeter (1911), **The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle**, Cambridge (Mass.): Harvard University Press.

3. L. A. Hahn, *with an introduction by* H. Hagemann (2015), **Economic Theory of Bank Credit**, (C. Matt, Trad.) United Kingdom: Oxford University Press, p156.

4. H. Hagemann (2014), **L. Albert Hahn's Economic Theory of Bank Credit**, Journal of Post Keynesian Economics, 37 (2), p.p. 309-335.

5. J. M. Keynes (1936), **The General Theory of Employment, Interest and Money**, London: Palgrave Macmillan.

6. W.F. Bassett, M.B. Chosak, J.C. Driscoll, & E. Zakrajsek, (2010), **Identifying the Macroeconomic Effects of Bank Lending Supply Shocks**, Federal Reserve Board, 26, 44.

7. I. Sharif (2010), **Bank credit and economic activity**, Journal of Business & Policy Research, Volume 5 (Number 1), p.p. 179 - 188.

8. D. Jacobs & V. Rayner (2012), **The Role of Credit Supply in the Australian Economy**, Australia: Reserve Bank of Australia.

9. S. Korkmaz (2015), **Impact of Bank Credits on Economic Growth and Inflation**, Journal of Applied Finance & Banking, 5 (1), p.p. 57-69.

10. I. E. Ananzeh (2016), **Relationship between Bank Credit and Economic Growth: Evidence from Jordan**, International Journal of Financial Research, 7 (2), p.p. 53-63.

11. L. Gambetti & A. Musso (2017), **Loan supply shocks and the business cycle**, Journal of Applied Econometrics, 32 (04), p.p. 764-782.

12. S. Ouliaris, A. Pagan & J. Restrepo (2018), **Quantitative Macroeconomic Modeling with Structural Vector Auto-regressions - An Eviews Implementation**, Washington DC: IMF Institute for Capacity Development, p45.

How to cite this article by the APA method:

Rym AMMARI (2020), **The macroeconomic effects of credit supply in Algeria: Evidence from a Restricted VAR analysis,** Algerian review of economic development, Volume 07(Number 01), Algeria: Kasdi Marbah University Ouargla, pp. 423-432.