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Financial development, economic growth and total factor productivity in Algeria: An empirical study

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Abstract---The objective of this study is to empirically test the relationship between the development of financial intermediaries and total factor productivity (TFP) in the case of the Algerian economy during the period 1970-2020. The research approach employed in this research paper consists on the development of an econometric model, using the vector autoregressive (VAR) approach and the causality test, in the sense of Granger. The variables used as indicators of financial development were the money supply ratio, the share of domestic credit granted to the private sector as a percentage of GDP, trade openness, foreign direct investment, and human capital. The results of the VAR model employed show that financial development has a positive and significant impact on TFP, through domestic credit to the private sector and trade openness, while the other variables have no significant effect on TFP.

Keywords---Financial Development, Economic Growth, TFP, Technological Progress, VAR model.

1 Introduction

For a long time, the economic literature is widely discussing about the determinants and the sources of economic growth mainly for a long-term view. In the Schumpeterian model (1911), the dynamics of sustained, long-term growth in a capitalist system lie in the development of innovations between entrepreneurs in a competitive market, characterised by a process of Creative Destruction (Aghion & Howitt, 1992). For Schumpeter, *"The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumer's goods, the new methods of production or transportation, the new markets ... (This process) incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism"* (Schumpeter, 1942, p 83). This Schumpeter-Aghion-Howitt model of endogenous growth, under the effect of technological progress, indicates the important role of institutions in innovative activities, R&D and in controlling transaction costs by developing a set of fundamental laws, structures and standards which establish the rules of the game (Davis & North, 1971) for a favourable environment, in which the Schumpeterian entrepreneur carries out his activity. In this Schumpeterian (1911) conception of economic growth, extended by Aghion & Howitt (1992, 1998), the process of economic growth is stimulated by financing the innovative activities of entrepreneurs by improving their productivity. There is a correlation between finance, technological progress, and economic growth.

The theoretical literature and Recent theoretical and empirical literature highlight several works dealing with the relationship between financial development and economic growth: Goldsmith (1969), Shaw (1973), McKinnon (1973) then King & Levine (1993), Levine (1997), Levine & Zervos (1998) and Levine, Loayza & Beck (2000). The latter concluded that financial development has a positive impact on economic growth through improvements in production techniques, innovation in new production or marketing procedures and capital accumulation. In addition, by combining the ideas of Schumpeter (1911) on innovation, those of Solow (1956) on growth and the ideas of North (1989) on institutions, King & Levine (1993) emphasised that there is a positive relationship between the development of financial intermediaries and economic growth through the improvement of total factor productivity (TFP) in an efficient institutional environment.

Like other developing countries, Algeria has implemented several financial and economic reforms as part of the transition to a market economy. This transition culminated in the adoption of a structural adjustment programme signed with the International Monetary Fund in 1994. On the financial front, the measures undertaken consisted of the restructuring, liberalisation and development of the financial system and the process of liberalisation of the banking system. On the financial front, the measures undertaken consisted of restructuring, liberalising, and developing the financial system. The liberalisation process was marked by law no. 90-10 of 14 April 1990, relating to money and credit. The aim is to develop a financial system in which financial institutions operate in favour of domestic investment and economic growth.

Besides, this article aims at verifying the relationship between financial development and total factor productivity in Algeria. The hypothesis says that

there exists a relation between both variables. To do so, the researcher started by reviewing the theoretical and empirical work explaining the relationship between financial development indicators and TFP (section 2). Next, an estimation of the VAR model, the causality test and the shock analysis are presented after estimating TFP (section 3). Finally, the results of the various stages of the study are discussed in section 4

2 Finance Development, Economic Growth and TFP

In the economic theory, it is always admitted that permanent and consistent economic growth is important for a country so that it to increase its long-term well-being. Economic growth can be the result of growth in inputs such as labour and capital, or in the technical efficiency of inputs, known as total factor productivity. The debate about the share of inputs compared to TFP is still ongoing.

2.1 Review of the Theoretical Literature

The analysis of growth sources dates to the late 1950s, when Jan Tinbergen, Moses Abramovitz (1956), and Robert Solow (1956) began to decompose the growth of production into the weighted average of the growth rates of labour, capital, and the residual which became known as the growth of total factor productivity (TFP). In the 1960s and 1970s, new contributions led to the use of more general production functions and more precise measurement of inputs and outputs (Jorgenson & Griliches, 1967; Denison et al., 1972).

TFP (Total Factor Productivity) is thus an important component of economic growth. On one hand, TFP growth helps to overcome the limits of the accumulation of physical, financial, and human capital: the savings rate, demographics, and natural resources (Serdaroğlu, 2015). On the other hand, productivity resulting from efficient resource use contributes to increasing the long-term growth rate and well-being. According to Aghion & Howitt (1992, 1998), education, research, and development (R&D) spending, technology transfer, trade openness, financial openness, the level of institutional and financial development, and macroeconomic stability can have a consistent effect on TFP and long-term economic growth.

Regarding the link between finance and TFP, it remains controversial in several empirical studies (Köse, Prasad, Rogoff, and Wei, 2007). Indeed, capital flows can lead to cycles of expansion and slowdown, particularly in economies with low institutional quality (Stiglitz, 2004). Some studies also show that financial development is an important determinant in the development of countries and contributes to maintaining macroeconomic stability globally (Serdaroğlu, 2015). In this perspective, the pioneering works of Bagehot (1873), Schumpeter (1911), Gurley and Shaw (1960), and Goldsmith (1969) have highlighted the inextricable links between finance and economic growth.

From the theoretical side of finance and growth, financial development is essential for economic activity by alleviating the constraint of domestic savings against the accumulation of capital necessary for increasing productivity. In Schumpeterian-

type AK growth models, technological progress is an important factor for long-term growth (Schumpeter, 1934; Aghion & Howitt, 1992). Financial development is identified as an important factor that shapes and promotes innovation and, consequently, economic growth driven by innovation and total factor productivity (TFP) (Asimakopoulous & al, 2019).

Thus, in his book "The Theory of Economic Development," Schumpeter (1911) asserted that the efficiency and dynamics of a financial system stimulate economic evolution based on technological innovation by facilitating the provision of credit to entrepreneurs. In other words, economic growth is achieved through technical progress which consists of permanent movements of destroying activities related to old innovations and creating new activities linked to new innovations. This process, called creative destruction, through innovation ensures a renewal of production structures, where new innovations displace the old ones, reduce their profitability, and grant entrepreneurs a new monopoly situation allowing them significant profits. The destructions and creations are two phenomena that go together, thus engendering transformations within economic activities.

King & Levine (1993) and Yano & Shiraishi (2020) also asserted that financial development facilitates the financing of innovation and R&D activities through improved credit and capital flows to innovative projects. On one hand, and on the other hand, the development of the financial sector deeply affects the remuneration of human capital in developed countries, hence the effects of finance on brain drain. Additionally, the development of financial instruments affects the allocation of resources, both on capital and labour. In other words, credit booms tend to undermine productivity growth by inducing labour reallocations towards sectors with lower productivity growth (Borio & al, 2016).

Moreover, numerous studies explore how the emergence of financial instruments, markets, and intermediaries can improve resource allocation, facilitate technological innovation, and stimulate economic growth. Some works show how financial systems can foster growth driven by innovation and total factor productivity (TFP).

Therefore, the results may be presented through the following functions:

- The reinvestment;
- Reducing project monitoring and corporate governance costs;
- Trade facilitation, hedging and risk pooling;
- The facilitation the accumulation of physical and human capital;
- Reducing transaction costs and promoting specialisation.

In all these models of contracts, the markets and financial intermediaries can foster the growth easing the constraints on the flow of capital to its most efficient uses.

2.2 Review of the Empirical Literature

Empirically, many studies have examined the link between financial development and economic growth. McKinnon (1973) examined the link between the financial system and economic development in Argentina, Brazil, Chile, Germany, Korea,

Indonesia and Thailand. The results of his study revealed that well-functioning financial systems stimulate economic growth. Thus, the level of financial development is an important determinant and a good indicator for predicting rates of economic growth, capital accumulation and technological change (King & Levine, 1993; Levine, 1997).

In a comparative study of the Maghreb countries (Algeria, Morocco and Tunisia), it was concluded through the construction of a composite index using the PCA method that, unlike in Morocco, in Algeria 86% of total banking assets in 2012 were held by public banks, which favour the financing of priority public projects (Kasmi, 2015). These projects, which are part of recovery programmes based on a logic of solidarity (agricultural development, basic infrastructure, housing construction, the fight against unemployment), cannot be considered as basic determinants of economic growth.

In their study entitled "Liberalisation of financial services and economic growth: the case of Algeria", Nemiri & Benahmed (2016) were able to show the positive impact of financial liberalisation on economic growth by estimating a structural VAR and testing for causality in the Granger sense. The estimation results revealed that the indicators of financial liberalisation, namely the bank liquidity ratio, the trade openness rate, and the dinar exchange rate, have a positive and significant impact on economic growth.

Nevertheless, it was stated that these results should be qualified given the particular structure of the Algerian economy (98% dependent on hydrocarbon exports, the real exchange rate of the dinar is not freely determined by the market but calculated by the Bank of Algeria in conjunction with the IMF according to the principle of "equilibrium exchange rate: TCEQ").

Another study dealing with the impact of financial development on economic growth in Algeria found mixed results (Nasri, 2017). Indeed, the variables: financial development activity (ADF), financial development efficiency (EDF), and financial development (DF) show no impact on variations in the growth rate while the size of the financial sector exerts a positive effect on the latter. The explanation put forward by the author is that the financial reforms implemented have not succeeded in satisfactorily developing the financial system by giving more importance to the development of the banking sector than to the development of the stock market, which remains underperforming and illiquid.

Still in the case of the Algerian economy, Zeghoudi & Abou-Bekr (2020) in their work devoted to examining the link between the country's level of financial development and its rate of economic growth by estimating a VAR model concluded that there was a positive short-term effect of domestic credit granted to the private sector and economic openness on economic growth in Algeria. However, no positive impact was found in the long term.

By introducing the quality of institutions into their study, Draa Messeouda & Zaid (2021) asserted that financial development in Algeria only affects economic growth through the liquidity ratio, while bank credit granted to the private sector has no significant effect. Thus, estimating the model by eliminating the institutional variable led to different results where the credit variable revealed a fairly

significant impact on economic growth. In addition, the analysis of shocks revealed a negative effect of financial freedom on growth. The conclusion drawn by the authors is that financial institutions do not have the financial freedom necessary for the development of the financial sector, particularly in terms of granting credit, which affects business productivity.

Serdaroğlu (2015) analysed the effect of financial liberalisation on TFP in Turkey by taking financial openness as an indicator of liberalisation in addition to human capital, foreign direct investment, financial development, macroeconomic consistency, and governance indicators. The estimation results obtained show that human capital, innovation, foreign direct investment, financial development, macroeconomic consistency, and institutional quality are the main determinants of the increase in TFP in Turkey. Nevertheless, trade openness only has a significant effect on TFP by improving the technological content of value added rather than by building a production assembly line. As for openness to capital flows, this variable has a significantly positive effect on TFP growth.

On the other hand, Cecchetti and Kharroubi (2015) and Borio & al. (2016) have pointed out that less productive but more hireable projects are easily financed when the financial sector is developed, i.e. when credit increases, talented workers are attracted to sectors with low productivity gains due to higher compensation in the financial sector (Celerier & Vallee, 2018). Nevertheless, easy access to credit may prevent companies from investing in R&D activities. In this sense, two opposing effects can be identified in the relationship between finance and growth. On the one hand, financial development generates externalities on the real sectors of the economy and promotes productivity; on the other hand, these positive externalities generate a process of creative destruction by discouraging companies from investing in R&D activities.

In the same vein, Aghion & al, (2018) argue that financial development can lead to two scenarios: the first is that potentially good innovators can have free access to finance to enter the market due to financial market development, and this will be beneficial for aggregate innovation and growth. The second is that less efficient firms' access to credit prevents more efficient innovators from entering the market. This in turn can be detrimental to innovation and aggregate growth.

De La Fuente & Marín (1996) assume that the probability of successful innovation depends on the degree of effort made by entrepreneurs and the search for information. This type of information leads to the emergence of financial intermediaries with contracts between financial intermediaries and entrepreneurs. With lower supervision costs, entrepreneurs can obtain more favourable loan conditions to encourage higher level innovation activities. Blackburn & Hung (1998) agree with De La Fuente & Marín (1996) in their conclusion, only in their model, R&D achievements are assumed to be private information and only firms know that innovation projects are successful.

However, other studies such as those by King & Levine (1993), Levine (1997), Levine & Zervos (1998) and Levine & al. (2000) find that the development of financial intermediation considerably favours total factor productivity (TFP) growth but has a weak link with capital accumulation. However, Rioja & Valev

(2004) find that the growth effect on TFP generated by financial intermediaries is more widespread in developed countries. Tadesse (1997), using industrial data, concludes that there is a positive and significant relationship between industrial data, technological progress, and financial development, but the influence of stock markets on technological progress is weak.

Inklaar & Koetter (2008) suggest that the relationship between certain traditional indicators of financial development and productivity is insignificant, but the efficiency of financial intermediaries has a significantly positive influence on productivity.

3 Empirical study

3.1 Estimation of Total Factor Productivity

Economically, this expression refers to the relationship between the transformation of primary inputs "K and L" combined by a technology "A" during the production process to give a quantity of outputs "Y". To determine the technological level of the Algerian economy, we estimate TFP using the Solow residual method with a Cobb-Douglas production function. However, this method requires the use of certain assumptions from neoclassical growth theory - being these assumptions about the technical characteristics of the factors of production - with constant returns to scale, factor substitution, wages and income are determined by the remuneration of the factors of production which are labour and capital respectively.

$$Y = F(A, K, L) = A_t F(K, L)$$

Consider a neoclassical Cobb-Douglas production function with constant returns to scale. This function is as follows:

$$Y = AK^\alpha L^\beta$$

Where :

Y: The output or value added of the economy, expressed as the volume of gross domestic product (GDP)

K: The stock of fixed capital.

L: The labour factor expressed by the level of the active population or the labour force.

A: The residual term that expresses the level of technology (TFP), including the product of R&D efforts, learning by doing, training, labour turnover, and knowledge externalities. In other words, it is the result of technological innovation or imitation. It is important to note that it is considered here that the technological change is largely due to the dynamics of the imitation and technology transfer process. Indeed, for the Algerian economy, a large part of its technological stock (base) is fed by FDI and international trade flows. On the other hand, the innovation process contributes less to this technological change.

α et β (with $\beta = 1 - \alpha$): The share of factor remuneration in total output (*Y*). Since returns to scale are constant, therefore ($\alpha + \beta = 1$). Where α and β were coefficients to estimate. The quantification of TFP corresponds to the ratio between the volume

of production "Y" and the production factors "K and L". TFP is therefore defined by the following formula:

$$TFP_t = A_t = \frac{Y_t}{K_t^\alpha L_t^\beta}$$

Table 1
Evolution of Growth Rate of Production Factors

	GDP	K	L	PTF
1970-1980	5,42304134	3,59768617	2,56282329	2,11678921
1981-1990	2,46378877	-1,48021357	2,66674545	0,41265148
1991-2000	1,96434046	0,56410403	2,81752217	-0,7212099
2001-2010	3,54839897	7,30922515	1,9753577	-0,05675237
2011-2020	1,43641938	2,0668756	0,79991459	0,18990298

Source: Calculation of Authors

We determined the time series of technological progress expressed by total factor productivity (TFP), using the growth accounting method. TFP for the Algerian economy has been calculated for the period 1970-2020, and our calculation approach is based on the real GDP, capital (K) and labour power (L) series. According to various theoretical and empirical works such as the study by Makdisi, Fattah & Limam (2003), the evolution of TFP is sensitive to the elasticities α and β of the production factors: capital and labour respectively.

Table 2
Breakdown of GDP growth rate (%)

	GDP	K	L	TFP
1970-1980	5,42	0,90	2,33	2,19
		16,59	43,00	40,41
1981-1990	2,46	-0,37	2,43	0,41
		-15,02	98,50	16,75
1991-2000	1,96	0,14	2,56	-0,72
		7,18	130,52	-36,72
2001-2010	3,55	1,83	1,80	-0,06
		51,50	50,66	-1,60
2011-2020	1,44	0,52	0,73	0,19
		35,97	50,68	13,22

Source: Calculation of Authors

Table 2 provides estimates of the relative contribution of capital, labour and TFP to economic growth in Algeria between 1970 and 2020. Overall, the results show the predominance of the contribution of labour over that of capital and TFP in growth performance over the period 1970-2020. Algeria recorded the lowest contribution of TFP to economic growth in the period 1991-2000, at - 0.72%.

When we calculated TFP on an aggregate basis, we found that the production function is of the Cobb-Douglas type with increasing returns to scale. The elasticities of the factors of production are equal to their remunerations in the production process, and there is a possibility of substitution of the factors of production. TFP in year "t" is given by the following formula:

$$TFP_t = A_t = \frac{Y_t}{K^{0,24} L^{0,91}}$$

$t \qquad t$

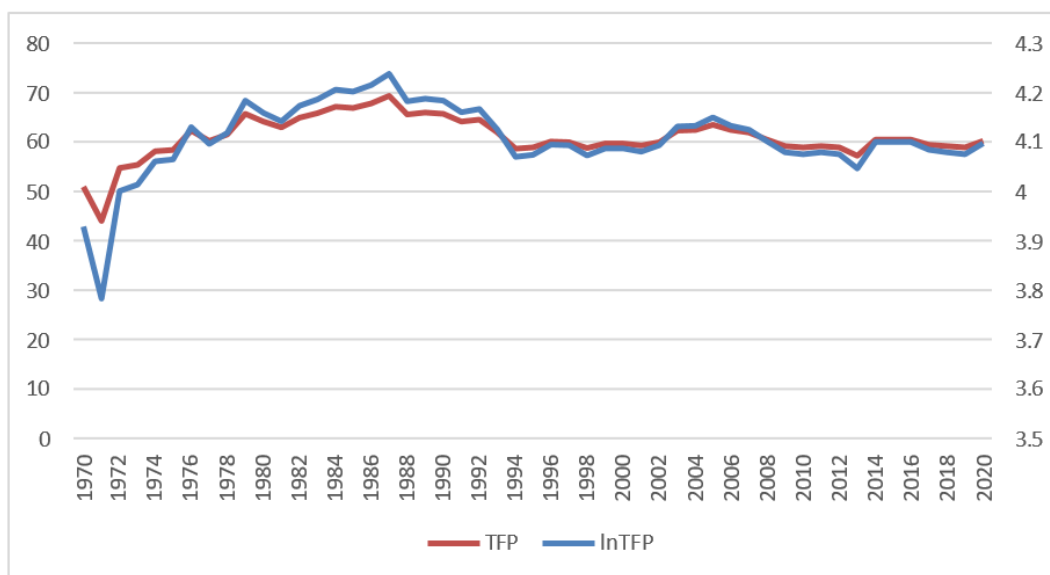


Figure 1. Evolution of TFP in Algeria (1970-2020)
Source: Calculation of authors

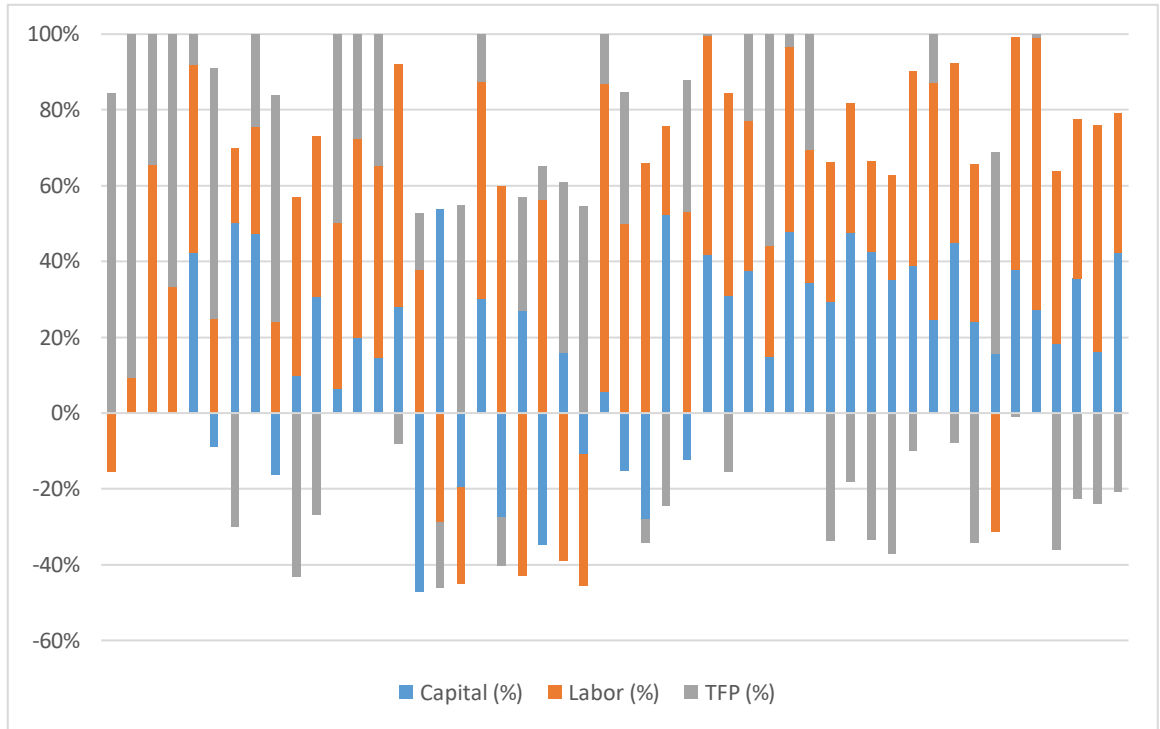


Figure 2. Breakdown of GDP growth rate over the period (1970-2020)

Source: Calculation of Authors

3.2 The Model

This subsection examines the relationship between financial development and total factor productivity (TFP). Financial development is measured by the variables most commonly used in theoretical and empirical work: domestic credit to the private sector (DCPS), money supply as a percentage of GDP (M2), foreign direct investment (FDI), trade openness (TO) and human capital (HC). The last two are taken as control variables. The data used come from the World Bank and cover the period 1970-2020. The model to be estimated is as follows:

$$TFP = (DCPS, M2, FDI, TO, HC)$$

$$TFP_t = c + \alpha_1 DCPS_t + \alpha_2 M2_t + \alpha_3 FDI_t + \alpha_4 TO_t + \alpha_5 HC_t + \varepsilon_t$$

3.2.1 Estimation of VAR Model

Before moving on to estimating the model using macroeconomic series, it is essential to study stationarity. To do this, we use the Dickey-Fuller augmented unit root test (ADF test). Table 3 shows that, except for FDI and TO, all the other series are not stationary at level. In fact, the PTF, M2 and DCPS series are stationary after the first difference, hence their integration of order 1. On the other hand, HC series are stationary after the second difference and are therefore integrated of order 2.

Table 3
Result of unit root testing (ADF)

	Model of test	ADF calculation	ADF tabulated	Integration Order
PTF (Model2)	1st Difference	-10.00534	-2.922449	I (1)
M2 (model3)	1st Difference	-5.473208	-1.947665	I (1)
DCPS (model 1)	1st Difference	-5.248398	-1.947665	I (1)
FDI (model2)	A level	-6.317669	-2.921175	I (0)
TO (model 1)	A level	-2.013606	-1.947520	I (0)
HC (model 1)	2 nd difference	-6.757205	-1.947816	I (2)

Source: Calculated by Authors Using EViews 12

Now, the next step is to determine the order of the VAR model using the LR, FPE, AIC and SC criteria. The table below gives an optimal number of lags equal to 1.

Table 4
Determination of order of Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-285.2664	NA	0.016873	12.94518	13.18606	13.03498
1	-207.9574	130.5664*	0.002732*	11.10922*	12.79543*	11.73782*
2	-183.1649	35.26037	0.004901	11.60733	14.73888	12.77474
3	-156.1788	31.18394	0.009267	12.00795	16.58483	13.71416
4	-119.1093	32.95065	0.014744	11.96042	17.98262	14.20543

Source: Calculated by the Authors using EViews 12.

In estimating the VAR model, the work consists of examining the effects of the past of each variable on itself and on the other variables. These results allow us to analyse the sign and significance of the coefficients on the variables. The results of estimating the VAR model (1) indicate that total factor productivity is explained by the variables: domestic credit granted to the private sector (DCPS) and the trade openness rate (TO), while the other variables do not play a role in explaining it.

Table 5
Results of VAR (1) Model Estimation

	DTFP	DM2	DDCPS	FDI	TO	DDHC
DTFP (-1)	-0.163223 (0.10430) [-1.56500]	0.124979 (0.48607) [0.25712]	-0.055570 (0.41961) [-0.13243]	0.001731 (0.00760) [0.22768]	0.163135 (0.11849) [1.37680]	-9.29E-05 (0.00032) [-0.28689]
DM2(-1)	0.016254 (0.03679) [0.44185]	0.126879 (0.17144) [0.74009]	0.364738 (0.14800) [2.46451]	0.000347 (0.00268) [0.12930]	0.017121 (0.04179) [0.40969]	-3.30E-05 (0.00011) [-0.28910]
DDCPS (-1)	0.085640 (0.03375) [2.53722]	0.090692 (0.15731) [0.57653]	0.096618 (0.13580) [0.71147]	0.000197 (0.00246) [0.08005]	-0.009012 (0.03835) [-0.23501]	-3.43E-05 (0.00010) [-0.32746]
FDI (-1)	0.648165 (2.17188)	-1.614158 (10.1221)	-5.272131 (8.73804)	0.105920 (0.15834)	-1.424020 (2.46743)	-0.005868 (0.00674)

	DTFP	DM2	DDCPS	FDI	TO	DDHC
TO (-1)	[0.29844]	[-0.15947]	[-0.60335]	[0.66895]	[-0.57713]	[-0.87039]
	0.119336	-0.117669	0.137726	-0.000728	0.963065	1.65E-05
	(0.04474)	(0.20850)	(0.17999)	(0.00326)	(0.05083)	(0.00014)
DDHC (-1)	[2.66741]	[-0.56435]	[0.76517]	[-0.22322]	[18.9481]	[0.11846]
	36.83387	106.2634	-630.4878	2.491906	14.09171	-0.023393
	(50.8114)	(236.807)	(204.427)	(3.70436)	(57.7259)	(0.15772)
C	[0.72491]	[0.44873]	[-3.08416]	[0.67270]	[0.24411]	[-0.14832]
	-3.847015	4.652168	-4.648104	0.074253	0.847735	0.000101
	(1.50540)	(7.01595)	(6.05663)	(0.10975)	(1.71026)	(0.00467)
	[-2.55547]	[0.66308]	[-0.76744]	[0.67657]	[0.49568]	[0.02166]
R-squared	0.307939	0.040997	0.325077	0.020172	0.917032	0.028206
Adj. squared	R-0.206662	-0.099345	0.226307	-0.123217	0.904890	-0.114007

Source: Obtained by the Authors Using EViews 12

3.2.2 Validation of VAR Model

Examining the robustness of the VAR model requires three tests. These are the residuals' autocorrelation, heteroscedasticity, and error normality tests.

Table 6
Tests of VAR (1) validation

Test	Statistic Test	p-value
Serial correlation LM test	0.940282	0.5709
White Heteroskedasticity Test	585.2162	0.2894
Normality Test	526.6332	0.0000

Source: Obtained by Authors Using EViews 12

The results of the first two tests show that there is no autocorrelation between the errors and that they are homoscedastic, hence the validation of the VAR (1) model. Nevertheless, the normality test is not verified.

3.2.3 Causality Study

The objective of the Granger causality test is to study the causal relationships that may exist between the different variables in the model. It involves examining the null hypothesis that the variable " α " does not cause the variable " β " in the Granger sense. The null hypothesis is accepted if the probability of the test is greater than 5%. On the other hand, if the probability of the test is less than 5%, the alternative hypothesis is accepted.

Table 7
Results Causality test sense of Granger

Obs		F-Statistic	Prob.
DM2 does not Granger Cause DTFP	49	1.45445	0.2340
DTFP does not Granger Cause DM2		0.00386	0.9507
DDCPS does not Granger Cause DTFP	49	11.7674	0.0013
DTFP does not Granger Cause DDCPS		0.20755	0.6508
FDI does not Granger Cause DTFP	49	0.02283	0.8806
DTFP does not Granger Cause FDI		0.05203	0.8206
TO does not Granger Cause DTFP	49	14.9705	0.0003
DTFP does not Granger Cause TO		0.68189	0.4132
DDHC does not Granger Cause DTFP	48	0.36614	0.5482
DTFP does not Granger Cause DDHC		0.10659	0.7456

Source: Obtained by Authors Using EViews 12.

Table N°7 shows two causal relationships: domestic credit granted to the private sector and the trade openness rate cause total factor productivity in the Granger sense, or the probability of the test is less than 5%. On the other hand, the three variables: money supply, foreign direct investment and human capital have no causal effect on total factor productivity. However, to go a little further, it is preferable to supplement this study with impulse analysis.

3.2.4 Chock Analysis

This study involves applying a shock to one variable and looking at the response of the other variables in the model. The graph below shows the response of the TPF to shocks to bank credit and the trade openness rate. We can see from the graph above that the results of the impulse response functions are consistent with those of the VAR estimation and the causality test. Indeed, a positive CDPS and TO shock exerts a positive effect from the second period on total factor productivity. The bank credit shock then diminishes and is cancelled out by the fourth period. The opening rate shock remains significant but stabilises throughout the following periods.

Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

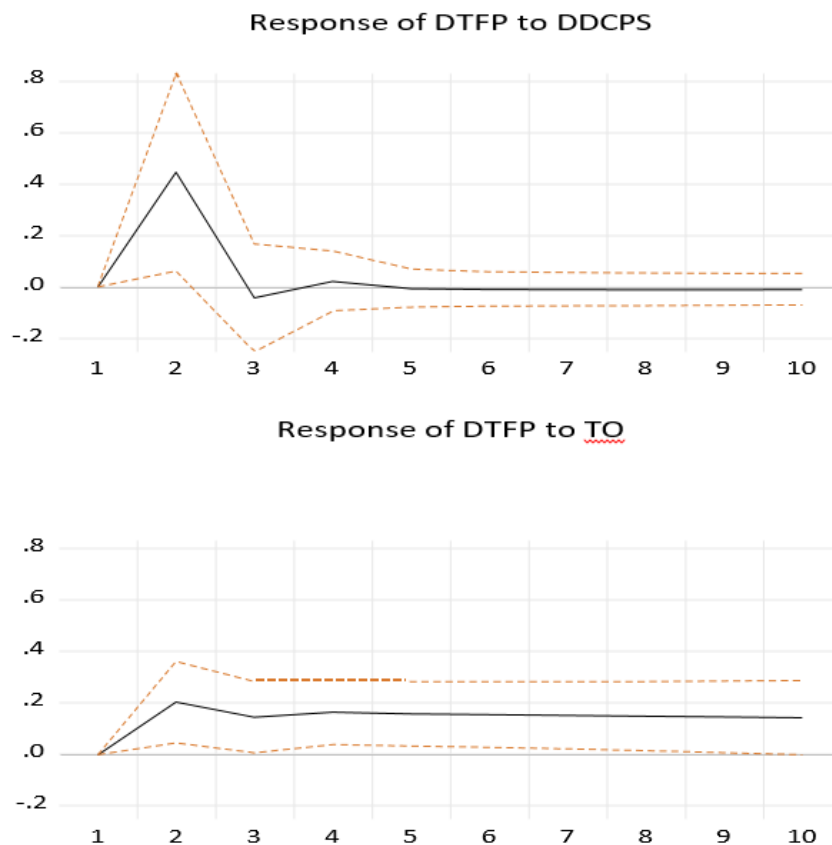


Figure 3. TFP response to CDPS and TO shocks
Source: Obtained by Authors Using EViews 12.

3.3 Results Discussion

The first result that emerges is that relating to the positive and significant impact of bank credit granted to the private sector on TFP. This result is not surprising given the size of the share of bank credit granted to the private sector. Indeed, an analysis of the figures for the banking sector in Algeria shows that the share of credit granted to the private sector has grown significantly, exceeding the share of credit granted to the public sector¹.

The growth rate of bank loans distributed to the private sector was 95.30% between 2010 and 2020. This result does not contradict those of previous studies of Algeria (Zeghoudi & Abou-Bekr, 2020; Nemiri & Benahmed, 2016). The second result is the positive impact of the openness rate on TFP. However, this result needs to be qualified because of the other variables involved in explaining the structure of the economy. Indeed, if the economy is closed, it may be less dependent on foreign trade, or because it is in the interest of the country to compensate for the lack of equipment with human capital by training its

population (e.g. the hesitation of Russia at the end of the 19th century and China at the beginning of the 20th century to open up to the outside world). In the case of the Algerian economy, the significance of the openness ratio simply reflects its dependence (98%) on its hydrocarbon exports.

However, the insignificance of the bank liquidity ratio is due to the fact that the money supply in Algeria is fuelled by external assets derived from hydrocarbon revenues. If this increase in money supply is not invested in the real economy, it will lead to higher prices rather than increased production.

The Granger causality test showed the existence of two causal and unidirectional relationships running from the CDPS and TO, to the TFP. This result is consistent with that of the estimation of the VAR model and that of the shock analysis. The latter revealed that a positive shock to bank credit has a positive effect on TFP from the second period onwards but becomes negative in the third period. Nevertheless, TFP becomes insensitive to the long-term credit shock (from the fourth period).

¹ The annual growth rate of credit allocated to the private sector was 3.45% in 2020, compared with just 2.57% for the public sector.

The information derived from the impulse analysis is twofold. The first is the impact of bank credit on TFP in the short term, which is not uniform and where credit may not be favourable to productivity (negative effect). This negative effect could be linked to the cost of credit, which limits SMEs' access to finance, confirming the idea of Rajan and Zingales (1988). The second is TFP's insensitivity to long-term credit, which can be explained by the nature of the projects receiving long-term financing. As pointed out above, long-term credit essentially finances non-profit public projects that do not contribute to the productivity of companies.

As for the openness shock, it is positive over the whole period, which is in line with theory since openness is generally beneficial to the economy of any country. However, this variable requires further investigation because of the nature of the goods imported and exported.

Algeria does indeed generate significant revenues, but these come from hydrocarbons (the raw material), and its imports consist mainly of finished consumer goods: petroleum products, medicines, dairy products, etc. This feature of Algeria's foreign trade does not encourage the development of local industry.

4 Conclusion

In this article, we attempt to examine the relationship between financial development and TFP in the case of the Algerian economy, on the basis of time series for the period (1970-2020). The research consisted in determining the impact of the variables: CDPS, M2, FDI, TO and HC, on TFP by estimating a VAR model. However, the latter was supplemented by the Granger causality test in order to determine the direction of causality in this relationship.

The results confirm the working hypothesis, indicating that the development of financial intermediaries affects TFP through bank credit and the trade openness rate. These results also mean that the sources of technical progress are exogenous and depend partly on openness to international trade. It is more a question of technology transfer than innovation. This finding is linked to the structure of the Algerian economy, which is dependent on hydrocarbons, and to the stage of development of both the financial system and the national production system.

Despite the reforms undertaken in the financial sector, with a view to involving it in the real sphere of the economy, the performance of this sector remains insufficient given the country's potential. Thus, improving growth through total factor productivity for the Algerian economy according to the Schumpeterian conception, improved by Aghion and Howitt (1992, 1998) (1992, 1998) is largely linked to the model of technological catch-up or imitation, particularly through openness to international trade. In this case, it is a question of combining strategic and interactive policies between the development of financial intermediaries (credit for SMEs, subsidies for workforce training, etc.), openness to international trade and TFP.

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