

The Impact of the Informal Economy and Poverty on Unemployment in Algeria: A Dynamic ARDL Simulation Study

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Abstract---This study aims to determine the impact of the informal economy and poverty on unemployment in Algeria during the period from 1991 to 2022, using the aggregate cointegration test and the ARDL model boundary test, as well as the Dynamic ARDL Simulation. The results of the study showed the existence of cointegration between the study variables. The long-term results showed a significant inverse relationship between the size of the informal economy and unemployment, while there is a significant positive relationship between unemployment rates and poverty. The short-term results showed a significant inverse relationship between the size of the informal economy and poverty with unemployment rates, while the shock results were consistent with the long- and short-term results.

Keywords---unemployment, informal economy, poverty, Dynardl.

JEL Classification: O17; J64; I32; C13.

1. Introduction

National economies suffer from various problems, most notably those resulting from informal activities, which have given rise to two trends: the formal economy and the informal economy. It is essential to view the informal economy as a process that is part of the global economy, such that when various global crises erupt, the informal sector begins to emerge in multiple economies, accompanied by rising unemployment rates and poverty indicators. All of this is countered by a recovery that is often long and weak at the same time, forcing governments to adopt radical macroeconomic policies to curb

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or contain the activities of the informal sector. Among the economic policies pursued are strict economic decisions such as the privatisation of state-owned companies and the dismissal of workers in public administrations, which have led to peak unemployment rates and a deterioration in the standard of living of the population. Due to the economic weakness of some economies, informal activities have gradually returned to normal, creating a cycle centred on the informal economy, unemployment, and poverty. In emerging markets and developing economies, the informal economy employs more than 70% of workers and accounts for about one-third of gross domestic product. This reduces these countries' ability to mobilise the tax resources needed to strengthen their economies in times of crisis, implement effective macroeconomic policies, and build human capital for long-term development (World Bank, 2021).

The informal economy is one of the development issues that Algeria hopes to address. Among the reasons for its growth are high unemployment and poverty rates, as well as the volatility of the Algerian labour market and the inability to provide job opportunities, except for the diversification of declared economic activities, which has forced it to pursue different monetary policies, including fiscal policy, which Keynesians believe to be more effective through the wise governance of its tools. At the end of the 1990s, the size of the informal economy reached its highest level compared to its beginning, reaching 30% of gross domestic product (World Bank, 2021). There are also other active groups that have not yet found employment opportunities and are therefore unable to meet their various needs, turning to the informal sector as a solution. Employment policies are therefore considered one of the most important priorities for any country implementing economic reforms and plans, as they achieve multiple objectives, including reducing unemployment and improving living standards.

Based on the various economic plans implemented in Algeria, the period after 1990 was the worst for the country, with an unemployment rate of 29.5% at the end of 1999 (ONS, 2021). This was due to new reform plans, such as the Stand-By Arrangement (SBA) reforms, which resulted in layoffs, with the employment rate falling by about 10% in 2000 compared to 1990 (ONS, 2021). This was accompanied by a deterioration in social conditions and an increase in poverty rates, with the expansion of the informal economy and the increasing diversity of economic activities that do not comply with various social and tax regulations, despite the fact that they provide employment opportunities. Although people living in poverty are more likely to work informally, the informal economy does not allow them to escape the cycle of poverty. As a result, the development issues that Algeria wants to address have faced many obstacles, not least of which is the impact of volatile oil prices on its economy and the shocks they cause. It is therefore necessary to understand the relationship between the informal economy, labour market mechanisms, and poverty, and to understand the incentives that compel individuals to join the formal sector, and to understand the speed at which these economic imbalances are developing.

The informal economy consists of activities carried out by individuals, families, and companies that evade, avoid, circumvent, dodge, exclude, and do not comply with the rules and agreements of existing institutions. They all include economic agents who engage in non-compliant behaviour that they seek to conceal (Feige, 2016). From a fiscal perspective, any activity that is not subject to taxation, cannot be measured, or is evaded, whether legal or not, is considered an informal activity (Tanzi, 1980). It is also considered to be a group of activities that are characterised by a large workforce, generate income easily, often do not require a high level of education, and are limited in scope but diverse in market (Hart, 1985). It is a group of companies and workers that carry out various activities outside the legal and regulatory frameworks and are not in line with the modern economy (De Soto, 1989). Despite the multitude of theories explaining the informal economy, four main schools of thought have emerged in the academic debate on the informal economy: dualism, structuralism, legalism, and voluntarism (Hernández, 2017) (Alter Chen, 2005). All of them consider individuals who are deprived of work in the formal sector to be important labour for the informal sector, regardless of their qualifications, as job opportunities may be available for them in this sector. Measuring the size of the informal economy is

linked to various other measurements, especially those related to labour market indicators, which in turn are also linked to the national average prices of various goods and services. As the informal economy does not require specific jobs or qualifications, it contributes to reducing unemployment rates and, in turn, increasing employment levels, albeit informally (Ali Boudlal, 2012). Furthermore, increases in public sector wages tend to negate the positive effects on job creation in the formal private sector and even the informal sector. With increases in public sector wages and a significant decline in recruitment, the government indirectly contributes to larger shares of the informal sector and adds pressure to rising unemployment rates (Yassin & Langot, 2018). On the other hand, we find that poverty is closely linked to unemployment and the informal economy in developing countries, as unemployment rates in these countries remain high due to the migration of large numbers of farmers to cities because of poor living conditions and a general lack of job opportunities, especially in rural areas. The unemployment rate is one of the factors that affect poverty, especially in developing countries, as the supply of labour still exceeds demand in most developing countries, especially among young people, and job opportunities in the private sector are scarce. Unemployment, therefore, increases poverty levels because it affects the poorest groups and unskilled workers (Wahiba Serraj, 2016). Based on this, the study's problem revolves around the following main question: What is the impact of the informal economy and poverty on unemployment in Algeria?

Several studies have addressed this topic from different angles. For example, a study by (boudjoufa, 2014) used Johansson's cointegration methodology and the VECM error correction model, in addition to Granger causality, to analyse the factors leading to the rise and fall of poverty and informal economy indicators in Algeria. The study showed a long-term equilibrium relationship between the size of the informal economy, poverty, and unemployment rates in Algeria during the study period. There is also a negative correlation between them, i.e., every increase in the informal economy is accompanied by a decrease in poverty and unemployment rates. The results of the causality test show a one-way causality from the size of the informal economy to poverty rates in the long term. To understand the relationship between poverty and the informal economy in Algeria, a study was conducted (Fatima El Wali, 2016) using Johanson's cointegration methodology in addition to Granger causality testing and least squares estimation between the study variables. The results concluded that there is a long-term equilibrium relationship between poverty and various other macroeconomic indicators used in the study (unemployment, economic growth, informal economy, inflation). The results of the causality test also showed that there is a relationship between poverty, the informal economy, and unemployment. Despite the large number of studies, their results varied depending on the time periods and models used.

However, there is still a clear research gap in the literature, as previous empirical studies, particularly in Algeria, have only used binary variables. In addition, this study is recent, taking into account the different stages that the Algerian economy has gone through and the shocks it has experienced. The main contribution of this study is to analyse the impact of the informal economy and poverty on unemployment in Algeria for the period from 1991 to 2022 using Dynamic ARDL Simulation, testing the causal relationship between variables, which enhances the scientific and practical value of the study.

2. Literature review

Numerous international studies have examined topics related to the informal economy, the labour market, and poverty. There have also been many studies on the relationship, impact, and effect between the informal economy and the labour market, the informal economy and poverty, and the labour market and poverty. There have been discrepancies and differences in the results of previous empirical literature, with some concluding that the effects are positive and others that they are negative, while other empirical literature has shown a complementary relationship between these indicators. In order to analyse the relationship between unemployment and the informal economy, time series from 1970 to 2017 specific to the Algerian economy were used, applying the SVAR methodology. The study "

(Dahmani, selmani, & bouzakri, 2019) concluded that there were changes in the size of the informal economy during the study period and that the period of its growth coincided with a significant increase in unemployment rates. In addition, there was a short-term correlation between the two, such that when there was a shock in unemployment rates, it was met with a positive effect in the two periods following the shock, with the size of the informal economy reaching 40% at the end of the second period, and then began to decline gradually. However, the study by (reda Dahmani, 2019) aimed to analyse employment in Algeria and determine its contribution to reducing unemployment rates, in addition to analysing the size of the informal economy using the CDA approach and estimating its size using the MIMIC approach. The relationship between the size of the informal economy and unemployment rates was then tested using the SVAR model, followed by testing the relationship between unemployment rates and the economic model according to Okun's law, based on the path analysis model. The results of the study concluded that the average size of the informal economy during the study period was approximately 25%, and that there was a positive statistical significance between unemployment and the size of the informal economy in the short term when there was a single positive structural shock, and that unemployment rates had an indirect negative effect on economic growth through the size of the informal economy. In order to analyse the relationship between poverty and unemployment indicators in Algeria during the period 1980-2018, based on the ARDL methodology, the results of the study (rimi, manah, & djouaidi, 2020) concluded that there is a long-term equilibrium relationship. The study also showed a significant positive impact of unemployment and poverty in Algeria during the study period and considered that the main cause of increasing poverty in Algeria is the high unemployment rates, which are due to the lack of job opportunities and imbalances in the Algerian labour market.

With the aim of analysing the relationship between unemployment rates and the shadow economy in Algeria and determining its impact, the size of the shadow economy was measured using the money demand approach, based on quarterly data from 1990 to 2018, obtained from during a study (Asmae Hassain, 2021), the size of the informal economy was approximately 33% at the end of 2018. To determine the relationship, the study relied on the ARDL methodology using quarterly data from 2002 to 2018, where unemployment rates had a significant inverse relationship with the size of the shadow economy in the short term, while in the long term, the relationship between them became proportional. As for GDP and self-employment, there was a positive and significant relationship with the size of the shadow economy in both the short and long term, with most self-employed workers preferring informal work. The results of the Toda and Yamamoto causality test showed that there was a one-way causality from unemployment rates to the size of the shadow economy. (Davidescu, 2015) study aimed to investigate the nature of the relationship between the shadow economy and unemployment rates in Romania using the ARDL methodology and based on quarterly data covering the period from 2000 to 2010. The results of the study estimated the size of the Romanian shadow economy using the currency demand approach, which showed that its size decreased during the analysed period from 36.5% at the end of 2000 to about 31.5% of GDP in mid-2010. The study also showed a statistically significant negative effect of unemployment rates on the size of the shadow economy, while long-term unemployment rates have a positive effect on the shadow economy. The results also revealed a long-term, unidirectional causal relationship extending from unemployment rates to the shadow economy. Based on annual data for 100 countries from 1990 to 2006 and using panel models and the GMM method, the results of the study (Rajeev & James , 2017) indicate that unemployed males contributed to an increase in the shadow economy, while the results for unemployed females were not significantly influential. The study also showed that a 10% increase in male unemployment corresponds to a 2% to 3% increase in the shadow economy. The study also confirmed that the size of the informal economy decreases with greater economic prosperity, greater economic freedom, and better and more effective governance. However, the size of the shadow economy and its relationship with unemployment in four European countries (Greece, Spain, Italy, and Germany) was estimated and analysed for the period from 1989 to 2012, based on the monetary approach and the method of Greece, Spain, Italy and Germany during the period from 1989 to 2012, based on the monetary approach and the least squares method, The study of (Mauleon & Sarda, 2017) concluded that there is a statistically significant

relationship between the estimated size of the shadow economy and unemployment in each of the countries found a statistically significant relationship between the estimated size of the shadow economy and unemployment in Greece and Spain, which have high unemployment rates, especially in the years following the 2008 global crisis. At the same time, no such relationship was found in two other countries, Germany and Italy, which have low or moderate unemployment rates.

With the aim of exploring and analysing the relationship between the shadow economy and unemployment, and based on annual data for the period between 1999 and 2015 for 34 countries, the study (Salkic & Japalak, 2019) used dynamic panel models and the ARDL methodology, concluding that there is a statistically significant positive relationship between unemployment and shadow economy activity in the short and long term. The study also showed that labour market dynamics have a significant impact on the size of the shadow economy. Using simultaneous equation modelling, the study (Sahnoun & Abdennadher, 2019) aimed to analyse the effects and causal links between the shadow economy and the unemployment rate in 38 developing countries and 40 developed countries during the period from 2000 to 2015. The results of the study showed a negative unidirectional causal relationship extending from the unemployment rate to the shadow economy in developing countries. In developed countries, there was a negative bidirectional causal relationship between the shadow economy and the unemployment rate. The study also concluded that in countries with good institutional quality, the unemployment rate is associated with a weak informal economy, while in countries with low institutional quality, it strongly drives the informal economy. Meanwhile, the study " (Pham, 2022) aimed to explore the two-way link between poverty and the informal economy using a dataset from about 100 developing countries during the period 1991-2017 and relying on Granger causality and the PVAR methodology. The study concluded that there is a complex causal relationship between poverty and the informal sector in developing countries. In addition, this relationship depends crucially on the level of economic development of the country, such that in lower-middle-income countries, the expansion of the shadow economy significantly reduces poverty rates. This is because limited access to the formal sector makes the informal sector an alternative where poor and low-skilled workers can find employment and avoid unemployment. Working in the informal sector is also the second choice for poor employees.

Through a systematic review of previous empirical studies, there is still a research gap in that previous empirical studies, especially in Algeria, used only binary variables, i.e., the informal economy and unemployment, the informal economy and poverty, or poverty and unemployment. Therefore, the relationship between the three variables was studied together in our study. The second point is evident in the study period, as the current study is considered recent compared to previous empirical studies because the end of the study period is 2022. The third point is the standard method used in the applied study, where the current study attempted to use some statistical tests that have undergone some modifications in recent years and have not been used in previous studies. The fourth point concerns the results of the study, as the previous results were significantly different due to differences in the samples studied, such as the difference in the results of developed countries compared to developing countries, in addition to the time periods of the samples studied, some of which were going through periods of recession, and others the opposite. Therefore, our study took into account the different stages that the Algerian economy has gone through and the shocks it has experienced. In addition to this section, this paper is divided into a section on previous studies, a section on methodology and results, followed by a section discussing the results, and finally a conclusion with recommendations for the future.

3. Data, Methodology, and Results

3.1. Study variables

Based on previous empirical studies that addressed the informal economy, unemployment, and poverty, and relying on economic theory that explained the relationship between these variables, the study

variables were selected as follows: the size of the informal economy, poverty rates, and the unemployment rate. Table 1 shows the definition and sources of the study data.

Table 1: Definition and sources of study data

Study Variables	Definition	Symbol	Source
Unemployment	Unemployment, total (% of total labor force)	UNEM	World bank
Informal Economy	The size of the informal economy (% GDP)	INF	World bank
Poverty	Poverty rates (%)	POV	Arab Development Portal

3.2. Descriptive study of the study variables

For the descriptive study of the time series for the study, covering the period from 1991 to 2022, as well as to understand their nature and characteristics and the extent of their homogeneity, we relied on graphical representations of the values of the study variables, in addition to descriptive statistical results. Figure 1 shows that the time series for the study variables fluctuated during the study period, but this fluctuation does not confirm the stability of the time series for the study variables. Descriptive measures will clarify whether this fluctuation was violent or not.

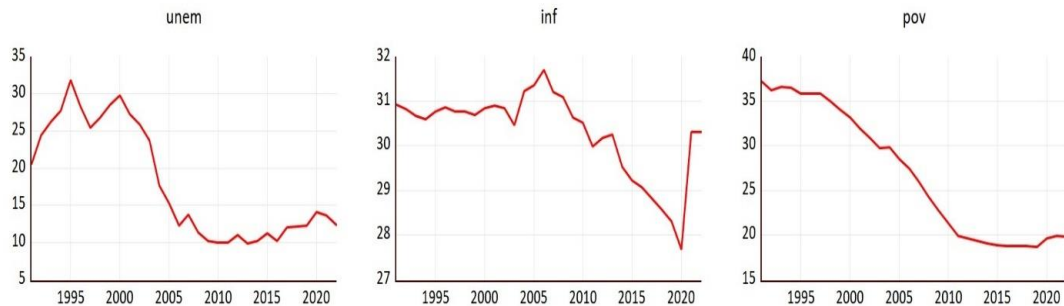


Figure 1: Time trend plots

As for Table 2, the values of the UNEM series during the study period recorded a maximum value of 31.84 in 1995 and a minimum value of 9.82 in 2013, with these values interspersed with significant inflation, as indicated by the range index for the series. The average of this series was estimated at 17.99 and the median at 13.92, while the standard deviation was 766, with a coefficient of variation of 42.58%. Through this, the values of the series were volatile and heterogeneous, as well as flat, despite the fact that the values of the series follow a normal distribution, as shown by the statistical value of the Kurtosis coefficient and the probability value of the Jarque-Bera statistic, respectively. The INF series values recorded a maximum value of 31.70 in 2006 and a minimum value of 27.66 in 2020, as these values were not accompanied by significant inflation, as indicated by the range index for the series. The average of this series was estimated at 30.30 and the median at 30.65, while the standard deviation was 09.4 with a coefficient of variation of 313.%. Through this, the values of the series were not volatile and homogeneous, but they were elongated, as indicated by the statistical value of the Kurtosis coefficient = 3.68. Their distribution was skewed to the right and did not follow a normal distribution, as indicated by the statistical value of the Skewness coefficient and the probability value of the Jarque-Bera statistic, respectively. With regard to the POV series values, the highest value was recorded in 1991 at 37.16, and the lowest value was recorded in 2019 at 18.69, with these values interspersed with average inflation, as indicated by the series' range index. The average of this series was estimated at 26.88, and the median

value was 26.71, while the standard deviation was 7.17 with a coefficient of variation of 26.688%. Through this, the values of the series were fluctuating and heterogeneous, as well as flat, despite the fact that the values of the series follow a normal distribution, as indicated by the statistical value of the Kurtosis coefficient and the probability value of the Jarque-Bera statistic, respectively.

Table 2: Descriptive statistics

	UNEM	INF	POV
Mean	17.99	30.30	26.88
Median	13.92	30.65	26.71
Maximum	31.84	31.70	37.16
Minimum	9.82	27.66	18.69
Std Dev	7.66	0.949	7.174
Skewness	0.417	-1.196	0.149
Kurtosis	1.485	3.689	1.36
Jarque-Bera	3.99	8.265	3.70
Probability	0.136	0.016	0.157
Observations	32	32	32

In addition to studying the previous descriptive statistical indicators and in order to learn more about the characteristics of the study variables, the strength of the correlation between them was analysed. The results in Table 3 show a weak positive correlation between the informal economy and unemployment, as well as a strong positive correlation between poverty and unemployment and between the size of the informal economy and poverty.

Table 3: Correlation matrix

	UNEM	INF	POV
UNEM	1.0000		
INF	0.4202***	1.0000	
POV	0.9033***	0.6433***	1.0000

Notes: (***) Significant at the 1%.

3.3. Study of time series stability

In order to determine the stability of the time series of the study variables, several qualitative and quantitative tests can be used, including autocorrelation analysis, Box-Pierce and Ljung-Box statistics, as well as unit root tests (ADF), (PP), (KPSS), and NG-Perron tests. These tests not only reveal the presence of instability but also determine the nature of the instability, whether it is TS or DS (Bourbonnais & Terraza, 2014). From Table 4, we observe that the probability value of the results of both the PP and ADF tests for the study variables is greater than the 5% confidence interval at the level, and from this, we accept the null hypothesis ($H_0: \phi_1 = 1$), i.e., the existence of a unit root. After taking the first differences, we observe that the probability value of the PP test results for the study variables is less than the 5% confidence interval, and therefore we reject the null hypothesis ($H_0: \phi_1 = 1$), i.e., there is no unit root, and therefore all series are integrated of degree I(1).

Table 4: Unit root results

ADF Test					
Variables	At Level		At First Difference		decision
UNEM	t-Statistic	-0.87	t-Statistic	-4.249***	I(1)
INF		-0.242		-6.162***	I(1)
POV		-1.752*		-2.056**	I(1)

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

3.4. Structural segment test

Through the results of qualitative and quantitative tests to study the stability of time series for the study variables, it became clear that all time series are stable to the same degree, I(1), which means that there may be a cointegration relationship between them. However, before proceeding with the cointegration tests, it was necessary to determine the possibility of structural breaks in the time series of our study and not to neglect them, because in the presence of structural breaks, cointegration methodologies that take into account structural breaks, such as the Gregory, Hansen and Hatemi-J methodologies, as Table 5 shows the results of the Zivot-Andrews test. From the results of this test, we note that the statistical values calculated for each of the series (INF, POV, UNEM) are greater than the tabulated statistical values at confidence levels of 5%. Therefore, we accept the alternative hypothesis that the structural breaks for 2005, 2010, and 2012 are not significant.

Table 5: Zivot-Andrews test results

	ZA statistic	structural break	1%	5%	10%
UNEM	-3.859	2010	-4.93	-4.42	-4.11
INF	-2.459	2005			
POV	-4.349	2012			

3.5. Cointegration by the Bounds Test Approach of the ARDL Model

The autoregressive distributed lag model (ARDL) is a dynamic model that emerged in the 1960s. It explains the dynamic relationship between the dependent variable, its prior values, and the lagged independent variables. This model was developed by Pesaran and Shen (1995) and Pesaran, Shen, and Smith (2001) to add bounds testing to the ARDL model. This methodology is known as the ARDL bounds testing approach, based on conditions and assumptions aimed at studying the dynamic relationship between the dependent and independent variables, testing the presence of a cointegration relationship, estimating an error correction model, and demonstrating the validity of the cointegration relationship. Accordingly, the study model will be as follows:

$$\Delta UNEM_t = C + \sum_{i=1}^P \beta_1 \Delta UNEM_{t-i} + \sum_{i=0}^P \beta_2 \Delta INF_{t-i} + \sum_{i=0}^P \beta_3 \Delta POV_{t-i} + \phi_1 UNEM_{t-1} + \phi_2 INF_{t-1} + \phi_3 POV_{t-1} + \varepsilon_t$$

Where:

Δ : Indicates first-order differences.

C: Constant term.

ε : Random error term.

P: The upper bound for the time lags included in the model.

$\beta_1, \beta_2, \beta_3$: short-term relationship coefficients.

ϕ_1, ϕ_2, ϕ_3 : Long-term relationship coefficients.

3.5.1. Testing Optimal Slowdowns

The optimal holding periods are determined according to several criteria, such as AIC, SC, and BIC, and through the results of Figure 2, we can see that the best model is ARDL (2,2,1).

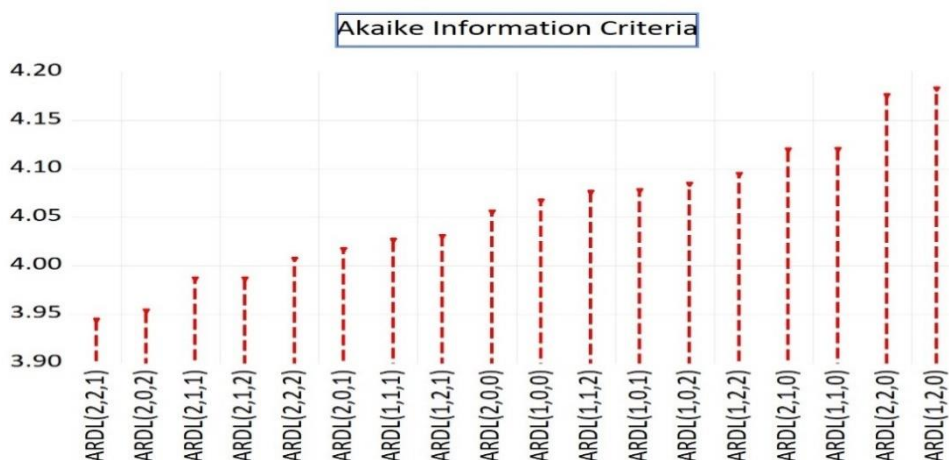


Figure 2: Model Selection Graph

3.5.2. Bounds test results

From the results of table 6, we can see that the calculated F value is 7.790***, which is greater than its tabulated value both at the lower limit $I(0)$ and at the upper limit $I(1)$ at different levels of significance of 1%, 5% and 10%, in addition to the critical values generated according to the methodology of Kripfganz and Schneider are smaller at the same levels of significance for different limits as well, so we reject the null hypothesis and accept the alternative, namely the existence of a co-integrating relationship Unemployment, Informal economy and Poverty in Algeria during the study period, while the calculated t statistic was equal to -4.105***, which is smaller than its tabulated value both at the lower limit $I(0)$ and at the upper limit $I(1)$ at different levels of significance of 1%, 5% and 10%, in addition to the critical values generated according to the methodology of Kripfganz and Schneider are smaller at the same levels of significance for different limits as well, so we reject the null hypothesis and accept the alternative, that is, the cointegration relationship Unemployment, Informal economy and Poverty in Algeria during the study period is logical cointegration relationship.

Table 6: Bounds test results

Test statistics	Value		Hypotheses					
F-statistics	7.790***		H0: No relationship					
t- statistics	-4.105***		H1: A Relationship exists					
Critical values of Kripfganz and Schneider and estimated p-values								
	10%		5%		1%		p-values	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F	3.38	4.57	4.24	5.61	6.35	8.18	0.004	0.013
t	-2.55	-3.22	-2.92	-3.63	-3.69	-4.49	0.004	0.021

Notes: (***) Indicates significant level at 1%.

3.5.3. Long-run and short-run relationship

From the results in Table 7, we observe that, with regard to the long-term relationship, the size of the informal economy has a significant negative impact on unemployment rates at a significance level of

5%, i.e., a 1% increase in the size of the informal economy corresponds to a 6.54% decrease in unemployment rates. The poverty index had a positive effect at a significance level of 5% with unemployment rates, as a 1% increase in poverty rates corresponds to a 1.52% increase in unemployment rates. As for the error correction parameter $\text{CointEq}(-1)$, it is equal to -0.517, which is statistically significant at the 5% level, meaning that 51.7% of errors are corrected in the first year. In the short term, we observe that the size of the informal economy has a significant inverse effect on unemployment rates at the 5% significance level, meaning that a 1% increase in the size of the informal economy corresponds to a 1.7% decrease in unemployment rates. The poverty index also had a negative impact at a significance level of 5% with unemployment rates, as a 1% increase in poverty rates corresponds to a 1.31% decrease in unemployment rates.

Table 7: Long and short-run relationship

Variables	Coefficient	Std. Error	t-Stat	Prob
Long-Run				
INF	-6.544	1.619	-4.05	0.001***
POV	1.521	0.144	10.51	0.000***
short-Run				
CointEq	-0.517	0.102	-5.049	0.000***
D(UNEM(-1))	0.280	0.135	2.063	0.050**
D(INF)	-1.70	0.501	-3.389	0.002***
D(INF(-1))	0.939	0.559	1.679	0.106
D(POV)	-1.311	0.541	-2.423	0.023**
C	89.94	17.86	5.03	0.000***

Notes: (**) Significant at the 5%; (***) Significant at the 1%.

3.5.4. Diagnostic tests

It can be seen from Table 8 that the probability value of the Jarque-Bera test was 0.512, which is insignificant at the 5% significance level, so we accept the null hypothesis that the residual series is subject to a normal distribution, while the probability value of the Breusch-Godfrey Serial Correlation LM Test was 0.892, which is not significant at the 5% significance level, so we accept the null hypothesis that there is no serial correlation issue between the residuals in the estimated models, and moving to the Breusch-Pagan-Godfrey and ARCH tests, we find that the probability values of these tests are not significant at the 5% significance level, as they were 0.852 and 0.633, respectively, so we accept the null hypothesis that the variance of the random error term in the estimated models is constant, and the Ramsey RESET test results confirmed the validity of the functional form of the estimated models.

Table 8: Diagnostic tests

Test	Test Statistic	Prob
Jarque-Bera test	1.338	0.512
Breusch-Godfrey Serial Correlation LM	0.114	0.892
Breusch-Pagan-Godfrey	0.460	0.852
ARCH	0.232	0.633
Ramsey RESET	0.275	0.612

Through Figure 3, we notice the stability of the constant and averages in the estimated model and this is shown by the CUSUM and CUSUM of Squares tests, and the same for the slope of the estimated parameters were all stable and therefore the estimated model and its parameters have structural stability, that is, there is stability between short-term results and long-term results at a significance level of 5%.

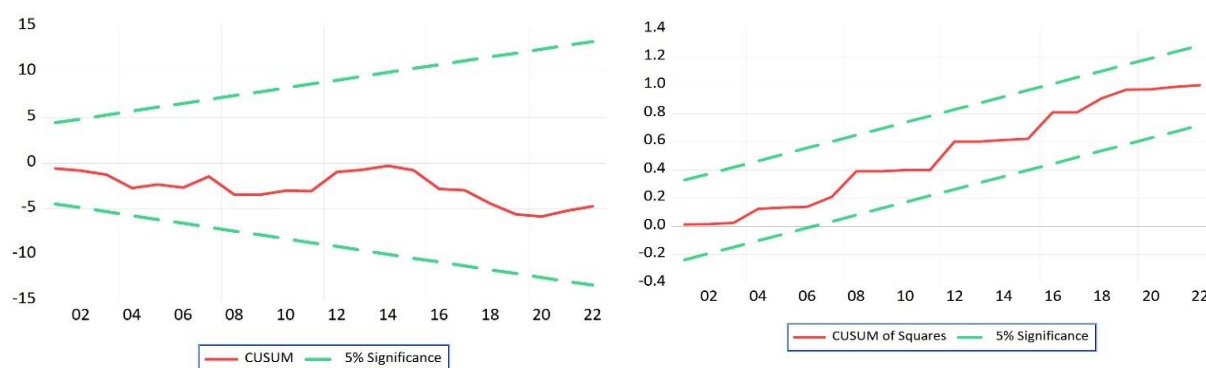


Figure 3: CUSUM and CUSUM square test

3.5.6. Dynamic Simulations of ARDL Models

With lags, contemporaneous values, first differences, and lagged first differences of the independent (and occasionally the dependent) variable appearing in the model specification, ARDL models may have a pretty complicated lag structure. Understanding the short-, medium-, and long-term effects becomes challenging as the model specification becomes more complex, even though interpreting the short- and long-term effects may be straightforward in something like an ARDL (1,1) model (i.e., one lag of the dependent variable, contemporaneous, and one lag of all independent variables).

Dynardl, a command for dynamically simulating a range of ARDL models, was introduced to simplify the interpretation of different outcomes and eliminate the complications associated with model specification. Results from various ARDL models are automatically estimated, simulated, stored, and plotted using Dynardl. An error correcting model can also be simulated by it.

Using stochastic simulation approaches, the output in Dynardl enables us to illustrate the impact of a counterfactual change in a single weakly exogenous regressor at a specific moment in time, while holding all other variables constant. The use of dynamic simulation techniques is growing in favor as a straightforward means of displaying the significant outcomes of time series models, whose coefficients frequently have "hidden" or counterintuitive meanings. (Jordan & Andrew , 2018)

Figure 4 illustrates the effect of a 10% positive and negative shock in the size of the informal economy on unemployment. A 10% increase in the size of the informal economy reduces unemployment rates from the tenth period when the shock occurs until the end of the fourteenth period, after which unemployment rates remain stable until the end of the period. When there is a 10% decrease, unemployment rates increase and then stabilise in the same way as the previous increase, which is consistent with the previous long- and short-term results.

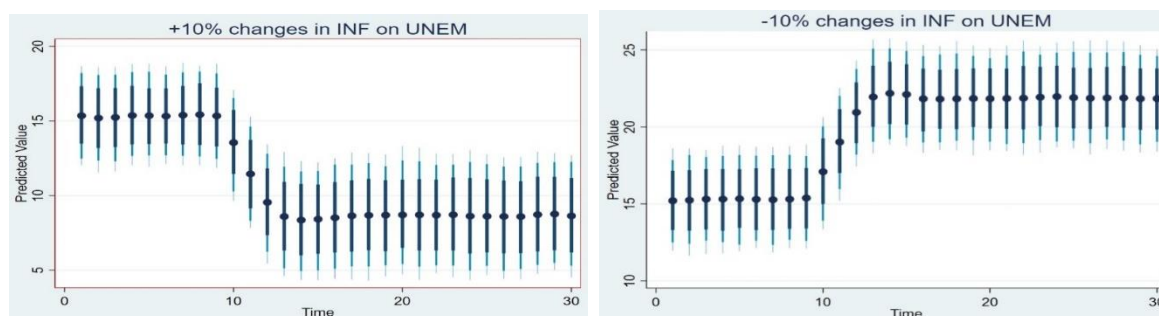


Figure 4: $\pm 10\%$ changes in INF on UNEM

Figure 5 shows the effect of a 10% positive and negative shock in the poverty rate on unemployment. A 10% increase in the poverty rate increases unemployment rates from the tenth period when the shock occurs until the end of the fourteenth period, then begins to decline until the end of the seventeenth period, and then begins to stabilise until the end of the period. When there is a 10% decrease, the opposite occurs, with the same increase pattern, which is consistent with the previous long-term results.

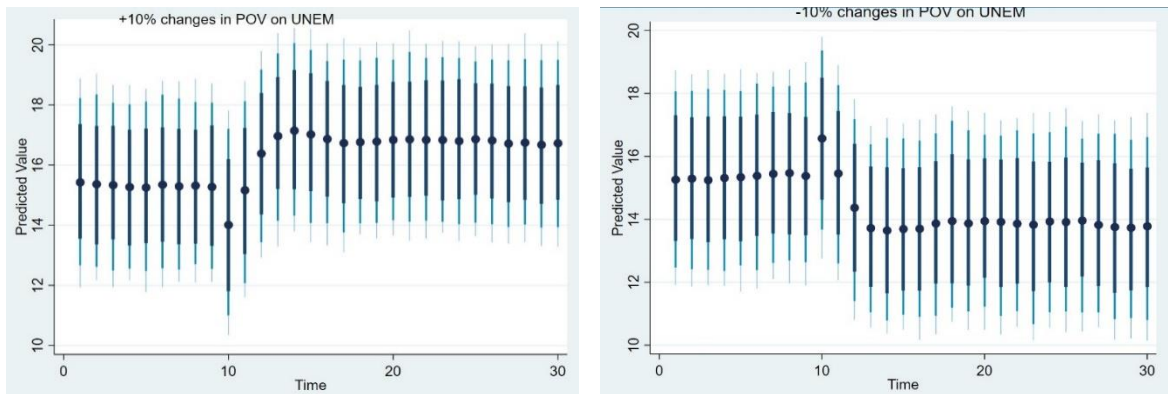


Figure 5: $\pm 10\%$ changes in POV on UNEM

4. Discussion

The various previous results show a joint integration relationship between unemployment, the size of the informal economy, and poverty. These results are consistent with some previous empirical studies, such as those by Boujrroufa (2014), Al-Wali (2016), Mokhtari and Bourich (2021), Tran (2021, Çelik, Keskin, & Keskin (2021), as these variables behave in the same way in the long term. Consequently, any fluctuation, whether positive or negative, in the Algerian national economy has the same effect on all variables. Algeria has undergone several stages of reform and implemented a number of fiscal and monetary policies, starting with the Second Credit Readiness Programme (1991), whose main objectives were to increase economic growth rates through mechanisms such as reducing informal activity and increasing spending on the employment sector to curb rising unemployment rates, which had seen a marked increase accompanied by a rise in various poverty indicators. Algeria followed the same strategy through its Structural Stabilisation Programme (1994/1995), one of whose objectives was to reduce unemployment rates, where the number of unemployed reached two million. This was accompanied by the imposition of measures to boost economic growth. The law on the privatisation of public institutions also had an impact on the size of the informal economy and unemployment rates, as well as poverty, as workers who had been laid off resorted to informal activities, with a deterioration in indicators such as social protection and final consumption. Algeria followed the same economic strategy in its economic recovery programme (2001-2004) and its two growth support programmes, especially the second one, which was accompanied by a period of recovery in oil prices, leading to new economic programmes. From this, we can conclude that the size of the informal economy, unemployment, and poverty followed the same pattern during the period 1991-2022 in Algeria, as all economic reforms and programmes addressed these variables and were focused on them by the Algerian state.

As for the mutual impact between unemployment rates and the size of the informal economy, this is consistent with some economic ideas that have proven that the informal sector is not necessarily a gathering place for the unemployed, but can also be a haven for the working classes, whether permanent or part-time. This is evident in the inverse relationship between the size of the informal economy and unemployment rates, which has also been shown in some empirical studies, such as the study by Boujrroufa (2014), Davidescu (2015), Karpushkina, Danilova, Voronina, & Savelieva (2021). In addition, despite being unemployed, the unemployed do not prefer informal activities, which may be

unsatisfactory to them, particularly in terms of wages or the services they provide. Furthermore, they believe that working in the formal sector is much better than working in the informal sector. This can be explained by the reform programmes implemented by the Algerian state to reduce unemployment, such as projects funded by the National Agency for Youth Support and Employment and unemployment grants, among others, as these strategies and mechanisms have become an incentive for the unemployed not to engage in informal activities. Unemployment rates affect and are affected by poverty, which is also consistent with economic theory and some previous studies, such as those by Ben Jaloul (2015), El Wali (2016), Ben Jaloul, Baali, and Felfoul (2019), Belkacem (2020), Belhadj (2023), Baaloul (2022), and Salem, Murad, Hengky, & Haitham (2020). Unemployment causes poverty in both the long and short term, as the unemployed are deprived of basic necessities, trapping them in a cycle of poverty. Improving their financial and social conditions is therefore linked to their access to employment, as demonstrated by various economic programmes, particularly in the second phase of Algeria's economic development, as mentioned above, which has been accompanied by a decline in poverty rates, as confirmed by the positive correlation between the two in the previous results.

5. Conclusion

To determine the impact of the size of the informal economy and poverty on unemployment in Algeria during the period from 1991 to 2022, the results of the joint integration boundary test, based on the methodology of autoregression of lagged time series, showed a joint integration relationship between the study variables. The long-term relationship also showed that the size of the informal economy has a negative impact on unemployment rates, while the poverty index has a positive impact on unemployment rates. As for the error correction parameter, it was statistically significant, meaning that 51.7% of errors were corrected in the first year. In the short term, the size of the informal economy had a statistically significant inverse effect on unemployment rates, while the poverty index also had a statistically significant inverse effect on unemployment rates. The results of the shocks showed that any shock, whether by one standard deviation above or below the mean in the size of the informal economy and poverty, affects unemployment throughout the periods following the shock, with the results consistent with those for the long and short term.

Based on the above results, the study concluded with a set of recommendations, including: the need to integrate the informal sector into the formal sector, as the number of workers in the formal sector can be considered small compared to the informal sector; revitalising the labour market by creating financial conditions in various sectors, while pursuing any policy or reform plan that contributes to absorbing unemployment and reducing poverty; Establishing a fund for the poor, revitalising the National Unemployment Fund, diversifying the economy by activating certain sectors and moving away from dependence on oil, establishing legal mechanisms that contribute to the census of various informal activities, as well as establishing various administrative facilities and tax incentives to facilitate the process of integrating the informal sector with the formal sector. Promoting investment opportunities and supporting start-ups that work to adapt the results of the education, scientific research, and vocational training sectors to the national economic and social environment and benefit from international experiences in combating unemployment and poverty. Involving all segments of society, especially the poor, in the economic development process, conducting a comprehensive survey and drawing on international experiences to do so, with the aim of conducting a comprehensive census of the poor and unemployed, as well as various informal activities, in order to adjust the strategy followed in addressing the various imbalances in the national economy.

After presenting the results obtained, in addition to some proposals related to the subject of our study, we noticed many research gaps that need further research, as the limitations of our study were an obstacle for us. In light of this, we propose some future studies that contribute to the subject of the study, the most important of which are the following: The informal economy, the labour market and poverty: a comparative study of Algeria and the Maghreb countries, studying a group of countries for

the same countries in order to determine the extent to which the results obtained can be generalised, in addition to predictive and forward-looking studies of these variables.

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