THE MACROECONOMIC DETERMINANTS OF UNEMPLOYMENT IN SUDAN OVER THE PERIOD 1990–2022

Ahmedia Musa Mohamed Ibrahim[1*], Badr eldeen Abdalmalik Alhaj Abouzeed[2]

[1]*Finance Department, College of Business Administration in Hawtat Bin Tamim, Prince Sattam bin Abdulaziz University, Hawtat Bin Tamim, Saudi Arabia; & Department of Economics, Faculty of Management Science and Economics University of Al-Butana, Sudan. Email: am.ibrahim@psau.edu.sa*
[2]*University of Kurdofan Faculty of Economics and commercial studies, Department of Economics. Email: Badralhaj2014@gmail.com*

ABSTRACT

This study investigates the macroeconomic determinants of unemployment in Sudan over the period 1990–2022 using annual time-series data from the Central Bank of Sudan, the Central Bureau of Statistics, and the World Bank. Ordinary least squares method (OLS) and Garanger causality were used. The regression results reveal that real GDP has a negative but insignificant effect on unemployment, indicating jobless growth. Investment exerts significant influences, highlighting the roles of capital formation in shaping labor market outcomes. Inflation, although negatively signed, is insignificant, suggesting the absence of a stable Phillips curve-type relationship in Sudan. The study finds that monetary expansion in Sudan is positively associated with unemployment, as a 1% increase in real money supply leads to a 24% rise in the unemployment rate. This suggests that liquidity is not effectively channeled into productive sectors, with weak monetary transmission and inflationary pressures limiting job creation. Exports in Sudan show a negative but weak elasticity with unemployment, indicating that growth in export activities does not significantly reduce joblessness. Granger causality analysis further shows unidirectional relationships: unemployment Granger-causes GDP and exports, while money supply, investment, and inflation Granger-cause unemployment. These results indicate that unemployment. Sudan is both a consequence of macroeconomic conditions and a driver of growth and trade performance. The findings imply that addressing unemployment requires more than short-term stabilization policies; structural reforms in education, skills development, industrial diversification, and labor market institutions are necessary to ensure inclusive and sustainable employment generation.

1. INTRODUCTION

Unemployment represents one of the most pressing macroeconomic challenges, as it reflects wasted resources and foregone opportunities for growth. Unemployed workers could contribute to national income and productivity, yet remain outside the production process. For job seekers, the end of the search process or access to better-paying positions is a relief, but at the macro level, persistent unemployment signals inefficiencies in the labor market and weak economic performance. As a key indicator of economic health, unemployment is influenced by a range of macroeconomic factors, making its study crucial for designing effective policy interventions.

A vast body of theoretical and empirical literature highlights the interconnectedness between unemployment and macroeconomic variables such as gross domestic product (GDP) growth, inflation, interest rates, exchange rates, money supply, investment, exports, and public spending. According to Keynes's General Theory of Employment, Interest and Money, employment levels are closely tied to aggregate demand. Unemployment arises when aggregate demand by households, firms, and government is insufficient for the economy to reach full employment output. The Keynesian solution to unemployment is therefore to stimulate demand through higher private consumption and investment—encouraged by lower interest rates or tax reductions—or through increased government spending (Jiancong, 2010). Rising demand stimulates production and incomes, which in turn reduce unemployment. Fiscal and monetary interventions, when implemented effectively, can thus play a central role in lowering cyclical unemployment.

Nonetheless, not all forms of unemployment are easily reducible. Frictional unemployment, caused by job search frictions, and structural unemployment, arising from mismatches between skills and labor market needs, cannot be eliminated entirely. Moreover, zero unemployment is not a feasible target in free-market economies. Still, public policies remain influential: job training programs, labor market regulations, unemployment insurance, minimum wage policies, and collective bargaining frameworks all shape the natural rate of unemployment and its responsiveness to macroeconomic conditions.

In Sudan, unemployment has emerged as a critical socio-economic issue undermining poverty reduction, social stability, and long-term development. Despite the country's abundant natural and human resources, employment generation has lagged behind the rapid expansion of the labor force, especially among youth and university graduates. Weak economic growth, insufficient domestic and foreign investment, limited industrialization, inflationary pressures, exchange rate instability, declining export performance, and demographic pressures are among the key macroeconomic challenges exacerbating unemployment. Political instability and policy uncertainty further compound these structural problems, discouraging private sector expansion and reducing labor absorption.

Given these dynamics, it becomes imperative to examine the determinants of unemployment in Sudan within a macroeconomic framework. While international studies provide useful insights, the Sudanese context—with its unique structural, political, and economic characteristics—requires a tailored empirical analysis. This study, therefore, seeks to identify and analyze the major macroeconomic determinants of unemployment in Sudan, providing evidence-based findings that can guide policymakers in designing strategies to reduce unemployment and promote sustainable economic growth.

2. LITERATURE REVIEW

The literature shows that macroeconomic variables significantly influence unemployment levels. However, the strength and nature of these relationships often depend on country-specific factors, time periods, and external shocks. Contemporary economic conditions, such as globalization and technological change, have also altered traditional dynamics, prompting ongoing research into these complex interactions.

Attahir. and Balla. (2020) examined the unemployment determinants in Sudan economy. The paper used a quantitative econometric approach. Assumed that an inverse relationship between the inflation rate and the unemployment rate. The result indicated that there was positive relationship between nominal wages inflation. Recommended using effective economic and rational policy to control inflation in nominal wages and thus influence the unemployment rate and its reduction, in order to improve the Sudan economy and improve the living level.

Omer O. A. (2021) finds that in Sudan, inflation has an insignificant negative effect on unemployment, and unemployment has an insignificant negative impact on economic growth, while inflation shows a weak positive relationship with growth. The study suggests that current

macroeconomic policies need strengthening, and that government investment in machinery and equipment could help accelerate economic growth.

Nour (2011) The study finds that positive and significant correlation between unemployment and inflation rates in Sudan during the period (2000-2008). unemployment in Sudan is mainly structural, driven by skills mismatches, demographic pressures, and a large informal sector, and argues that structural reforms and economic diversification are needed to create jobs.

Abdulrahman, Soliman, and Adam. (2016) investigated from an empirical point of view, the relationship between unemployment and inflation in Sudan during the period 1992-2015. Using these data, Granger test is applied to estimate the causal relationship between unemployment and inflation. The results provided that unemployment does not Granger cause Inflation, and inflation dose not Granger cause unemployment. Thus, there is no causality relationship between inflation rates and unemployment rates in Sudan from 1992-2015.

Himali L. P. (2022) shows that living sector, gender, education level, and language barriers significantly affect unemployment, while age, gender, and education influence its duration. The study indicates that highly educated individuals may struggle to find jobs matching their qualifications, and highlights substantial gender differences in unemployment experiences.

Chopra and Neethu (2021) investigate the link between economic growth and unemployment, highlighting the negative relationship described by Okun's Law. They identify key determinants of unemployment, including inflation, exports, foreign direct investment, population growth, labor force participation, gross fixed capital formation, and interest rates. The study underscores the importance of effective policy measures in mitigating unemployment.

Sinha (2022) finds that in Bihar, capital stock and human capital investment significantly stimulate economic growth in the long run, while inflation negatively affects real GDP. Unemployment shows no significant impact on output. In the short run, the economy adjusts toward equilibrium at a speed of about 32% annually, implying a recovery period of nearly three years after shocks.

Evanezza and Caroline (2024) investigated how inflation, GDP, and foreign direct investment impact youth unemployment in Malaysia. It finds that inflation and GDP have a negative relationship with youth unemployment, while FDI shows a positive relationship. Hie, and Lam. (2025) investigated how inflation affects unemployment risks across different worker groups. It finds that supply-driven inflation disproportionately increases unemployment risks for vulnerable workers, while demand-driven inflation has varying effects based on race and unemployment reasons. The authors emphasize the need for inflation stabilization to promote equitable labor market growth. Ali. et,al **(2024)** explored the relationships between unemployment and various macroeconomic factors in Romania. It finds a negative relationship between economic growth and unemployment, confirming the existence of Okun's law during 2007-2013. Conversely, government size significantly reduces the unemployment rate in Romania. Inflation and trade are negatively associated with unemployment, while taxation has a positive impact.

Boulila & Mignon (2009): The study finds that the Phillips curve does not hold in African countries, as unemployment is mainly structural and inflation is driven by supply-side shocks, implying that structural reforms—not inflation control alone—are needed to reduce unemployment. Moursi and El Mossallamy (2010) The study shows that Egypt's monetary policy responds strongly to exchange rate movements mainly to control inflation, but this focus constrains its effectiveness in addressing unemployment and structural issues

3. THEORETICAL FRAMEWORK

Unemployment is influenced by a complex interplay of macroeconomic factors that operate through labor market mechanisms, aggregate demand and supply, and policy interventions. The theoretical framework synthesizes key economic theories explaining these relationships.

3.1. The Phillips Curve and Inflation-Unemployment Trade-Off

The Phillips Curve (Phillips, 1958) posits an inverse relationship between inflation and unemployment in the short run, suggesting that lower unemployment can be achieved at the cost of higher inflation. This theory was foundational in understanding labor market dynamics but was later refined to incorporate expectations. High inflations do not promote growth of GDP and lower unemployment, except perhaps in the beginning. At the height of hyperinflation growth is negative and unemployment increases Bernholz, (2003). Everyone agrees that expansionary monetary policies tend to lead to increases in inflation, while contractionary policies produce decreases in inflation. At this broad level, monetary policy would appear to be a matter

of trading off inflation and output. Since unemployment tends to decrease as output increases, this is often cast a choice between inflation and unemployment. The empirical relationship between the two is called the Phillips curve Matthias, e.tal. (1999). In the same line Friedman (1968) and Phelps (1967) introduced the concept of the natural rate of unemployment, where unemployment returns to a baseline level determined by structural factors, regardless of inflation in the long run. They argued that attempts to reduce unemployment below this natural rate with inflationary policies would only lead to accelerating inflation.

3.2. Keynesian Theory and Aggregate Demand

Keynesian economics emphasizes the role of aggregate demand in determining employment levels. Insufficient demand leads to unemployment, and active fiscal policy, such as increased government spending, can stimulate demand and reduce unemployment.

Keynes (1936): The Keynesian theory argues that unemployment results from insufficient aggregate demand, with sticky wages and prices preventing automatic adjustment, thus requiring government intervention through fiscal and monetary policy to restore full employment.

3.3. Monetary Policy and Interest Rates

Friedman (1968): The monetarist theory, through the natural rate of unemployment hypothesis, argues that in the long run unemployment gravitates toward a natural rate determined by structural factors, and attempts to reduce it through expansionary policies only generate higher inflation without sustainable employment gains. Monetary policy affects unemployment through its influence on interest rates. According to the IS-LM model (Hicks, 1937),

lower interest rates encourage investment and consumption, boosting aggregate demand and reducing unemployment. Conversely, contractionary monetary policy can raise unemployment in the short term.

3.4. New Keynesian Theory

New Keynesian Theory: The New Keynesian explains unemployment as a consequence of wage and price rigidities, imperfect competition, and the efficiency wages hypothesis, firms may choose to pay wages above the market wages to increase productivity, but this practice generates persistent involuntary unemployment Mankiw, (1985) and Stiglitz, (1987). In addition, economists commonly classify unemployment into three main categories according to their underlying causes: frictional, structural, and cyclical (David, 2006). Frictional unemployment occurs when individuals are searching for new jobs or transitioning between positions, while structural unemployment emerges from long-term changes in technology, industrial composition, or the structure of demand, often leading to permanent job losses. Cyclical unemployment, by contrast, is associated with economic recessions and downturns in the business cycle, and is generally regarded as temporary. This classification provides a useful framework for analyzing the persistence and dynamics of unemployment in different economic contexts.

4. SOME MACROECONOMIC INDICATORS IN SUDAN (1990–2022)

Variables include in table.1 unemployment (UN), gross domestic product (GDP), money supply (M2), inflation (INF), investment (IN), exports (XP), and population (POP).

Table 1: Summary of Macroeconomic Indicators in Sudan (1990–2022).

year	GDP	XP	in	M2	in	un
1990-1994	1267.344	135.91	122.44	267.67	99.1	14.72
1995-1999	21854.59	1998.88	3064.39	2175.70	43.8	13.82
2000-2004	59715.40	7349.04	8686.27	8186.32	7.5	16.06
2005-2009	127041.70	20766.61	25150.50	24866.40	10.8	15.78
2010-2014	274668.58	26045.15	46373.19	64480.20	29.4	16.68
2015-2022	280387	861885.74	41192.98	6918099	143.4124	13.3875

Source: Author's Calculations

Table (1) presents the average values of selected macroeconomic indicators in Sudan for the period 1990–2022. The results reveal significant fluctuations in the country's economic performance. Gross domestic product (GDP) increased remarkably from an average of 1,267.34 million SDG during 1990–1994 to 274,668.58 million SDG in 2010–2014, reflecting the impact of oil exploitation and economic reforms

(World Bank, 2020; Central Bank of Sudan, 2018). However, growth stagnated in the period 2015–2022 despite a dramatic expansion in money supply, which reached 6,918,099 million SDG, indicating the prevalence of inflationary financing and macroeconomic imbalances (IMF, 2021). Exports also rose sharply, from 135.91 million SDG in the early 1990s to 861,885.74 million SDG in the last period,

driven largely by oil and primary commodities (World Bank, 2019). Investment showed an upward trend until 2010–2014, when it peaked at 46,373.19 million SDG, but later declined to 41,192.98 million SDG, reflecting political instability and the impact of South Sudan's secession in 2011 (Elbadawi & Schmidt-Hebbel, 2016). Inflation exhibited cyclical patterns, with extremely high levels in the early 1990s (99.1%), a decline to single digits during 2000–2004 (7.5%) supported by oil revenues, and a sharp surge after 2015 (143.4%) due to fiscal deficits and exchange rate depreciation (Central Bureau of Statistics, 2022). Unemployment remained persistently high across all sub-periods, fluctuating between 13% and 17%, despite strong growth in GDP and exports. This suggests that economic expansion in Sudan has not been inclusive, as structural unemployment, weak labor market absorption, and limited diversification hindered employment creation (Ali & Elbadawi, 2012). Overall, the evidence indicates that Sudan's macroeconomic performance has been characterized by high volatility, growth driven by resource dependence, and persistent challenges of inflation and unemployment.

5. METHODOLOGY AND DATA

5.1. Data Sources

This study employs annual time series data for Sudan covering the period 1990–2022. The variables include unemployment (UN), real gross domestic product (RGDP), broad money supply (RM2), inflation (INF), investment (RIN), exports (RXP), and population (POP). Data were collected from the Central Bank of Sudan, the Central Bureau of Statistics, and the World Bank's World Development Indicators (WDI).

5.2. Model Specification

To identify the macroeconomic determinants of unemployment in Sudan, the study adopts a multiple regression framework. The functional form of the model is expressed as follows:

$$UN_t = (RGDP,$$
$$RM2, RIN, XP, INF, POP) \dots \dots \dots \dots \dots \dots (1)$$

The econometric form of the model is given by:

$$UN_t = \beta_0 + \beta_1 RGDP + \beta_2 RM2 + \beta_3 RIN + \beta_4 XP$$
$$+ \beta_5 INF + \beta_6 POP + \beta_7 UN_{t-1}$$
$$+ \emptyset_t \dots \dots \dots \dots \dots \dots (2)$$
$$\boldsymbol{\beta_0} \text{ is constant}$$

$\boldsymbol{\beta_1, \dots \dots \beta_7}$ were coefficient of explanatory variable expected sign of (RGDP), broad money supply (RM2), inflation (INF), investment (RIN), exports (RXP) negative, while population (POP) lag of unemployment$_{(t-1)}$ positive.
$\emptyset_t$ is the error term

5.3. Estimation Techniques

The study applies Ordinary Least Squares (OLS) regression to estimate the relationship between unemployment and the selected macroeconomic variables. Prior to estimation, unit root tests (ADF) are employed to determine the stationarity properties of the series. If variables are integrated, co-integration analysis (Johansen test) is conducted to assess long-run equilibrium relationships.

5.4. Granger Causality Test

To further examine the direction of causality between unemployment and macroeconomic variables, the study employs the Granger causality test within a Vector Autoregressive (VAR) framework. The Granger test evaluates whether past values of one variable contain information that helps predict another variable. For example, the null hypothesis "RGDP does not Granger cause unemployment" is tested against the alternative "RGDP Granger causes unemployment."

The general form of the Granger causality model is:

$$Y_t = \alpha_o + \sum_{k=0}^{k} Y_{t-1} + \sum_{j=0}^{k} X_{t-1} + \varphi_t \dots \dots \dots \dots \dots (3)$$

Where:
Y_t and X_t, represent the variables under consideration
k, optimal lag length determined by information criteria (AIC, SIC)
φ_t is the error term

6. EMPIRICAL RESULTS

6.1. Descriptive Statistics

The descriptive statistics reveal considerable variability in macroeconomic indicators, particularly in investment, money supply, and exports, while unemployment and population appear relatively stable. Most variables deviate from normality, with evidence of skewness, leptokurtosis, and significant Jarque-Bera statistics. These findings suggest a dynamic but volatile economic environment, due to weak of data in the development country.

Table 1: Descriptive Statistics.

Item	EM	RGDP	RM2	RIN	RXP	POP
Mean	14.91212	746.9937	380.3956	537.0397	256.5063	33079.69
Median	14.90000	797.5137	154.5824	109.6931	78.37308	34512.00

Maximum	22.90000	1140.175	2557.014	4628.609	2050.712	40347.27
Minimum	7.500000	0.006148	38.99170	16.39405	8.866279	23079.00
Std. Dev.	2.876930	340.5004	590.1023	1106.828	465.4883	4944.676
Skewness	0.546719	-0.430293	2.341953	2.751803	2.770081	-0.632626
Kurtosis	4.780922	1.831267	7.865783	9.562562	9.854122	2.156382
Jarque-Bera	6.005023	2.896501	62.72038	100.8657	106.7995	3.179760
Probability	0.049662	0.234981	0.000000	0.000000	0.000000	0.203950
Sum	492.1000	24650.79	12553.05	17722.31	8464.709	1091630.
Sum Sq. Dev.	264.8552	3710097.	11143062	39202165	6933740.	7.82E+08
Observations	33	33	33	33	33	33

Source: Author's Calculations

6.2. Augmented Dickey Fuller (Adf) Test

Augmented Dickey Fuller (ADF) test has revealed that Log RGDP, LogUN, LogRIN, LogRM2, LogXP, LogINF and LogPOP are nonstationary in level but when the variables are converted into first difference becomes stationary and the LogIN is stationary in level so this is mixed type in this case, we can run Multiple regressions and casualty.

Table 2: Augmented Dickey Fuller (Adf) Test.

Augmented Dickey-Fuller test statistic						
variable	D	t-Statistic	1%cv	5%cv	10%cv	Prob.*
LogRGDP	1	-6.72181	-3.59246	-2.93140	-2.60394	0.0000
LogEM	1	-4.88390	-3.66166	-2.96041	-2.61916	0.0004
LogRIN	0	-4.02228	-3.59246	-2.93140	-2.60394	0.0031
LogRM2	1	-3.75674	-3.58850	-2.92973	-2.60306	0.0064
Logpop	1	-6.67934	-3.59661	-2.93315	-2.60486	0.0000
LogINF		-7.169304	-3.565430	-2.919952	-2.597905	0.0000
MacKinnon (1996) one-sided p-values.						

Source: Author's Calculations

6.3. Co-Integration Analysis

The Johansen trace test was applied to examine the presence of long-run relationships among the variables in the model.

Table 2: Co-Integration Tests.

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.949295	218.0343	95.75366	0.0000
At most 1 *	0.881107	125.6005	69.81889	0.0000
At most 2 *	0.735190	59.58490	47.85613	0.0027
At most 3	0.385254	18.39385	29.79707	0.5371
At most 4	0.091515	3.310930	15.49471	0.9510
At most 5	0.010769	0.335637	3.841466	0.5624

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

The results show that the null hypothesis of no co-integration is strongly rejected at the 5% significance level, as the trace statistic (218.03) exceeds the critical value (95.75) with a probability of 0.0000. Similarly, the null hypothesis of at most one co-integrating equation is rejected (125.60 > 69.81, p = 0.0000), and the null of at most two co-integrating vectors is also rejected (59.58 > 47.85, p = 0.0027). However, from the fourth equation onward, the trace statistics are below the critical values, and the probabilities are large (>0.05), indicating failure to reject the null hypothesis. Therefore, the test results confirm the existence of three (3) co-integrating equations at the 5% significance level.

6.4. Estimation Coefficients of Model in Equation (2) For LOG (UN) Model

From table 3 it is clear   the regression model demonstrates a reasonably strong explanatory power, with an R-squared value of 0.7287, indicating that nearly 73% of the variation in the dependent variable is explained by the included regressors. The adjusted R-squared of 0.6496 confirms the model's adequacy, while the F-statistic (9.21, Prob = 0.000016) is highly significant, indicating the overall robustness of the model.

Estimation Coefficients of Model in Equation

(2) For LOG (UN) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(RGDP)	-0.218872	0.138821	-1.576648	0.1280
LOG(RM2)	0.247847	0.120467	2.057393	0.0507
LOG(POP)	0.682910	0.454552	1.502380	0.1460
LOG(RIN)	-0.228993	0.107972	-2.120857	0.0445
LOG(RXP)	-0.050604	0.014147	-3.577122	0.0015
LOG(EM(-1))	0.502630	0.165088	3.044619	0.0056
LOG(INF)	-0.034766	0.035129	-0.989677	0.3322
C	-4.389122	4.106718	-1.068766	0.2958
R-squared	0.728747			
Adjusted R-squared	0.649631			
F-statistic	9.211160			
Prob(F-statistic)	0.000016			

Source: Author's Calculations

The results presented in Table (3) showed that in the long run, real GDP has a negative and insignificant effect on the rate of unemployment in Sudan. Specifically, holding other factors constant, a 1% rise in real GDP is associated with a 12% decrease in the unemployment rate over time. This outcome suggests that economic growth in Sudan has not been strongly employment-generating. One possible explanation is the dominance of capital-intensive sectors, particularly oil, which contributed substantially to GDP growth during the 2000s but created limited job opportunities for the labor force. In addition, structural distortions in the economy — such as a narrow production base, dependence on natural resources, and weak industrial and manufacturing sectors — restricted the ability of growth to absorb labor (Ali and Elbadawi, 2012; IMF, 2021).

Moreover, political instability, poor governance, and the secession of South Sudan in 2011 disrupted growth trajectories and weakened the link between output expansion and labor market outcomes (World Bank, 2020). The mismatch between labor market skills and the needs of growing sectors further reduced the employment elasticity of GDP. Therefore, while the negative sign indicates that higher GDP is generally associated with lower unemployment, the statistical insignificance reflects the structural and institutional challenges that limit the capacity of economic growth to translate into sustainable job creation in Sudan.

The coefficient of money supply is positive and marginally significant at the 1% level. This suggests that monetary expansion is associated with an increase in unemployment. Specifically, holding other factors constant, a 1% rise in real money supply is associated with a 24% increase in rate of unemployment over time, possibly reflecting ineffective monetary transmission mechanisms or the misallocation of liquidity toward non-productive activities, as well as inflationary pressures that fail to stimulate real job creation.

The coefficient real investment is negative and significant at the 5% level, confirming that higher investment contributes to reducing unemployment. Specifically, holding other factors constant, a 1% rise in investment is associated with a 22% decrease in the unemployment rate over time. This finding consists with Keynesian theory and endogenous growth models, which emphasize the crucial role of investment in boosting aggregate demand and generating employment opportunities.

The coefficient real exports are negative and highly significant at the 1% level, suggesting that export expansion reduces unemployment by enlarging external markets, increasing demand for domestic production, and consequently boosting labor demand. Specifically, holding other factors constant, a 1% rise in real exports is associated with a 5% decrease in the unemployment rate over time. Exports in Sudan show a negative but weak elasticity with unemployment, indicating that growth in export activities does not significantly reduce joblessness. This is mainly due to structural weaknesses, such as dependence on primary commodities, low value-added production, limited labor absorption, and weak linkages with other sectors. Policy distortions, infrastructure gaps, and skill mismatches further constrain the ability of exports to generate employment, highlighting the need for diversification and investment in labor-intensive industries.

The regression results show that the coefficient of inflation is negative but statistically insignificant, suggesting the absence of a stable Phillips curve-type relationship in the Sudanese economy. This outcome implies that variations in inflation do not exert a systematic influence on unemployment. The insignificance can be attributed to the structural nature of unemployment in Sudan, which is largely caused by skills mismatches, rapid population growth,

weak industrial capacity, and the dominance of the informal sector. In addition, inflation in Sudan has historically been volatile and mainly cost-push in nature, driven by exchange rate depreciation, food and fuel price shocks, and political instability, rather than by demand-side factors. Under such conditions, higher inflation tends to distort investment and reduce output instead of lowering unemployment, thereby undermining the Phillips curve trade-off. These findings are consistent with previous studies on developing economies, which argue that inflation targeting alone cannot address unemployment problems without parallel structural and institutional reforms.

Although the population coefficient is positive, it is statistically insignificant, suggesting that population growth does not exert a clear and direct impact on unemployment, likely due to limited absorptive capacity of the economy.

The coefficient of lagged unemployment is positive and significant at the 1% level, highlighting the persistence effect of unemployment. This means that unemployment in the previous period has a direct positive impact on current unemployment, reflecting the structural and rigid nature of the labor market.

6.5. Normality and Functional Form Test

The Jarque-Bera test for normality compares the third and fourth moments of the residuals to those of the normal distribution and analyzes under the null hypothesis of normal distribution.

The result of the residual analysis tests for the equation is summarized in table (4). It can also be observed that the residuals are normally distributed in model.

Table 4: Normality And Functional Form Tests.

Model	Normality				Functional form		
	(Jarque-Bera)		Kurtosis	Skewness	AIC	Ramsey Reset	
	F-statistic	Prob				F-statistic	Prob
Ln (RGDP	14.4154	0.0004	5.9573	-0.2740	0.942828	0.704169	0.4884

Source: Authors' Calculation.

6.6. Autocorrelation and Heteroscedasticity Tests

The famous test which used to detect the autocorrelation problem is that Darbin-Watson (D-W) test, and also, we used test to detecting the autocorrelation problem. The results of these tests are summarized in the table (5) below. Also, we used the Arch test to know where the models are suffering from heteroscedasticity problem or not.

*Table 5: Autocorrelation And Heteroscedasticity Tests.*

model	Autocorrelation			Heteroscedasticity	
	D-W	Breusch-godfrey		Arch	
		F-statistic	Prob	F-statistic	Prob
(RGDP)	1.91	3.522103	0.0096	3.267477	0.2627

Source: Authors' Calculation.

Table (5) above shows that White heteroscedasticity test statistic with cross terms it is significant, suggesting that there is no heteroscedasticity in the models. Table 5 above shows that the Durbin Watson test is almost close equal to 2 Breusch-Godfrey test statistics for serial correlation is significant for the model.

6.7. Stability Testing of The Parameter

The plots of the CUSUM in Figs (1) below are obtained from a recursive estimation of the model. These plots indicate stability in the coefficients of the models.
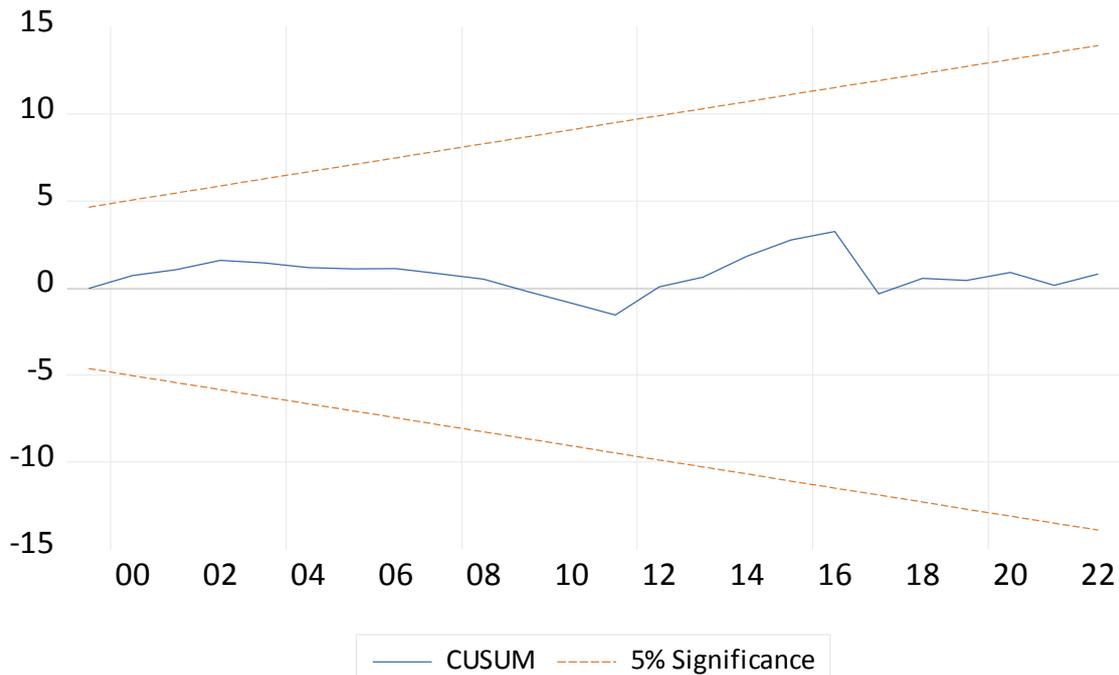
6.8. Granger Causality Analysis of Unemployment Determinants:

Understanding the causal relationships between unemployment and its potential determinants is crucial for designing effective macroeconomic policies. While economic theory suggests that economic growth, investment, exports, and monetary expansion influence unemployment, the empirical evidence is often mixed, especially in developing economies. This section employs the Granger causality test to investigate the direction of causality between unemployment (UM) and its key determinants: real GDP (RGDP), money supply (RM2), investment (RIN), exports (RXP), and inflation (INF), using annual data for the period 1990–2022.

Granger Causality Analysis of Unemployment Determinants

Null Hypothesis:	Obs	F-Statistic	Prob.
RGDP does not Granger Cause EM	31	0.03744	0.9633
EM does not Granger Cause RGDP		4.40191	0.0226
RM2 does not Granger Cause EM	31	3.92875	0.0323
EM does not Granger Cause RM2	31	1.32242	0.2838
RIN does not Granger Cause EM	31	4.21573	0.0260
EM does not Granger Cause RIN		1.42349	0.2590
RXP does not Granger Cause EM	31	1.75084	0.1935
EM does not Granger Cause RXP		14.5554	6.E-05
INF does not Granger Cause EM	31	3.82650	0.0349
EM does not Granger Cause INF		0.62472	0.5433

6.8.1 The Findings Reveal Several Important Insights

Economic Growth and Unemployment

Unemployment Granger-causes GDP, but GDP does not Granger-cause unemployment. This challenges the classical Okun's law relationship, suggesting that the economy experiences jobless growth. Growth in output is not sufficient to absorb labor, possibly due to structural unemployment, low labor market flexibility, or a capital-intensive growth pattern.

Monetary Policy and Unemployment

Money supply Granger-causes unemployment, indicating that expansionary monetary policy can reduce unemployment. This aligns with the Keynesian perspective on demand stimulation, but the absence of reverse causality implies that policymakers may not adjust monetary policy in

direct response to labor market conditions.

Investment And Unemployment

Investment influences unemployment significantly, confirming the accelerator theory that higher investment creates employment opportunities. However, unemployment does not affect investment, suggesting that investors' decisions are driven more by profitability, risk, and policy environment than by labor market slack.

Exports And Unemployment

Unemployment affects exports, but not vice versa. This implies that a rising unemployment rate weakens export performance (via productivity decline or loss of competitiveness). The lack of causality from exports to unemployment suggests that the export sector is capital-intensive rather than labor-intensive, hence weak in generating employment.

Inflation And Unemployment

Inflation Granger-causes unemployment very weak, but unemployment does not Granger-cause inflation. This provides evidence for a Phillips curve relationship in the short run, where inflationary pressures affect labor market conditions. However, the absence of feedback indicates limited cost-push wage effects.

7.   CONCLUSION   AND RECOMMENDATION

7.1. Conclusion

1. The regression results reveal that real GDP has a negative but insignificant effect on unemployment, indicating jobless growth.
2. Money supply and investment exert significant influences, highlighting the roles of monetary policy and capital formation in shaping labor market outcomes.
3. The study finds that monetary expansion in Sudan is positively associated with unemployment, as a 1% increase in real money supply leads to a 24% rise in the unemployment rate. This suggests that liquidity is not effectively channeled into productive sectors, with weak monetary transmission and inflationary pressures limiting job creation.
4. Inflation, although negatively signed, is insignificant, suggesting the absence of a stable Phillips curve-type relationship in Sudan.

5. Exports in Sudan show a negative but weak elasticity with unemployment, indicating that growth in export activities does not significantly reduce joblessness. This is mainly due to structural weaknesses, such as dependence on primary commodities, low value-added production, limited labor absorption, and weak linkages with other sectors. Policy distortions, infrastructure gaps, and skill mismatches further constrain the ability of exports to generate employment, highlighting the need for diversification and investment in labor-intensive industries.
6. Granger causality analysis further shows unidirectional relationships: unemployment Granger-causes GDP and exports, while money supply, investment, and inflation Granger-cause unemployment.

7.2. The Recommendations

1. The findings highlight economic growth, investment, and export expansion as the most critical determinants in reducing unemployment. Thus, policies should prioritize enhancing the investment climate, encouraging productive sectors, and promoting export-oriented strategies.
2. The positive relationship between money supply and unemployment suggests that monetary policy may have been ineffective or misdirected, requiring better alignment of credit allocation with productive activities.
3. The persistence of unemployment over time underlines the need for structural labor market reforms, including improving labor mobility, strengthening vocational training, and aligning education outcomes with labor market requirements.
4. Granger causality results highlight the dual role of unemployment in Sudan's economy. On one hand, it is determined by money supply, investment, and inflation, reflecting the impact of macroeconomic policies and cost-push pressures.
5. On the other: unemployment itself Granger-causes GDP and exports, demonstrating its critical importance as a driver of economic performance. The policy implication is that addressing unemployment should be a central priority for Sudan, as reducing it not only alleviates social pressures but also stimulates growth and enhances external competitiveness.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCES

Abdulrahman, B. M. A., Soliman, S. A. A., and Adam M, A. A. (2016) "The relationship between unemployment and inflation in Sudan: An empirical analysis, 1992–2015", Research in Economics and Management. Academia

Ali, A. A, and Elbadawi, I. A. (2012) "Explaining Sudan's Economic Growth Performance", African Development Bank Working Paper.

Ali, M, Radulescu, M, Usman, M, Mohammadreza, S. Hagiu, A.and Serbanescu, L. (2024)"Unemployment Rate and Its Relationship with Government Size, Trade, Inflation, Urbanization, and Economic Growth in Romania", journal homepage. (cell.com).

Attahir. A, M and Balla. T, A (2020) "Estimating the Determinants of Unemployment in Sudan by Applying the Philips Curve Using the E GARCH Model during the Period 1990-2018", International Journal of Innovative Science and Research Technology, Volume 5, Issue 4, April – 2020 ISSN No: -2456-2165. IJISRT20APR308 www.ijisrt.com 172.

Bernholz, P. (2003). "Monetary Regimes and Inflation History, Economic and Political Relationships", Published by, Edward Elgar Publishing Limited. The Lypiatts, 15 Lansdowne Road Cheltenham, Glos GL50 2JA. UK.

Boulila, G., and Mignon, V. (2009). "Inflation, structural change and the Phillips curve: New estimates for African countries", Economic Modelling, 26(6), 1182–1190.

Central Bank of Sudan, (2018). "Annual Report". Khartoum: CBS.

Central Bureau of Statistics, (2022) "Statistical Yearbook", Khartoum: CBS.

Chopra, C. and Neethu, B (2021) "Astudy of determinant of unemployment", International Journal of Education, Modern Management, Applied Science & Social Science (IJEMMASSS), ISSN: 2581-9925, Impact Factor: 6.340, Volume 03, No. 02(IV), April - June, 2021, pp.113-122.

David A (2006) "Introduction to Macroeconomics Dilts", Department of Economics and Finance Room 340D Neff Hall School of Business and Management Sciences Phone 481-6486 Indiana - Purdue University - Fort Wayne

Elbadawi, I., and Schmidt-Hebbel, K. (2016). "Sudan's Growth and Reform Challenges", Journal of African Economies, 25. (suppl 1), i1–i25.

Evanezza, M. and Caroline G (2024)"Macroeconomic Factors Affecting Youth Unemployment in Malaysia", MJBE Vol. 7 (December, No. 2), 2020, ISSN 2289-6856 (Print), 2289-8018 (Online), jurcon.ums.edu.my

Friedman, M. "(1968). The role of monetary policy", American Economic Review, 58(1), 1–17.

Hicks, J. R. (1937) "Keynes and the "Classics"; a suggested interpretation", Econometrica, 5(2), 147-159.

Himali L P,(2022) "Determinants of Unemployment and Unemployment Duration," International Research Journal of Advanced Engineering and Science, Volume 5, Issue 4, pp. 113-119, 2020.

International Monetary Fund (IMF). (2021). Sudan: 2021 Article IV Consultation Staff Report. Washington, DC: IMF.

Jiancong, C (2010) "Some Theoretical and Empirical Aspects of the Process of Economic Development in China since the Reforms of Deng Xiaoping", Thesis presented to the Faculty of Economics and Social Sciences at the University of Fribourg (Switzerland), in fulfillment of the requirements for the degree of Doctor of Economics and Social Sciences

Keynes, J. M. (1936). "The General Theory of Employment, Interest, and Money", Macmillan.

Ligia, V. V., and Daria, S. (2022). "Determinants of Unemployment - Empirical Evidence from Commonwealth of Independent States", International Journal of Academic Research in Business and Social Sciences, 12(10), 2051 – 2077.

Mankiw, N. G. (1985). "Small menu costs and large business cycles", A macroeconomic model. Quarterly Journal of Economics, 100(2), 529–537.

Matthias, D. Andreas, and Andrew,W (1999) "Macroeconomics"m typeset in Palatino and Computer Modern using LATEX. Draft of 1 September 1999.

Moursi, T. A., and El Mossallamy, M. A. (2010) "Monetary policy response to exchange rate movements", The case of Egypt. African Development Review, 22(3), 592–602.

Nour, S. S. O. M. (2011) "Labour market and unemployment in Sudan", UNU MERIT / University of Khartoum. IDEAS/RePEc

Omer. O, A (2021) "Inflation and Unemployment Trade-off: Is Phillips Curve True for African Developing Countries? Evidence from Sudan", Journal of Economic Science Research, Volume 04, Issue 03. July 2021.

Phillips, A. W. (1958). The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861–1957. Economica, 25(100), 283–299.

Sinha (2022) "Economic impact of unemployment and inflation on output growth in Bihar during 1990–2019", Journal of Development Economics and finance, January 2022.

Stiglitz, J. E. (1987). "The causes and consequences of the dependence of quality on price", Journal of Economic Literature, 25(1), 1–48.

World Bank. (2019) "World Development Indicators",. Washington, DC: World Bank.

World Bank. (2020). "Sudan Economic Monitor". Washington, DC: World Bank.