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Analyzing the long-term relationship between unemployment and economic growth in Saudi Arabia: A VECM approach

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ABSTRACT

This study examines the relationship between unemployment and economic growth in Saudi Arabia (1991–2023), incorporating control variables such as the current account balance, school enrollment, government expenditure, inflation, oil rents, and the manufacturing and services sectors. Using a Vector Error Correction Model (VECM), we analyze both long- and short-term dynamics. Results indicate a significant long-term negative association between unemployment and GDP, current account balance, education, government spending, inflation, oil rents, and services sector performance, aligning with Okun's Law. In contrast, manufacturing exhibits a positive relationship with unemployment, suggesting sector-specific labor market challenges. Short-term analysis reveals that roughly 20% of disequilibrium corrects annually, with GDP and current account balance driving immediate unemployment reductions. The findings underscore the need for policies that stimulate sustainable growth, enhance education, and prioritize job creation, particularly in the services sector.

1. Introduction

Unemployment is a critical global challenge in labor markets and a significant barrier to economic development. It undermines international economic integration by reducing productivity and competitiveness, discouraging domestic and foreign investment, weakening consumer demand, fueling political and social instability, and exacerbating trade imbalances (Saani et al., 2023). In developing economies, unemployment is particularly acute, highlighting inefficiencies in resource utilization. Achieving full employment should be a core objective of macroeconomic policy, as it has the potential to stimulate economic growth and improve overall performance. Economic growth, in turn, enhances well-being, raises living standards, and reduces poverty, making it a central goal for governments worldwide (Hjazeen et al., 2021). While developed nations have made some progress in reducing unemployment rates, this is not necessarily the case for developing countries, particularly in sub-Saharan Africa and the Middle East (both oil-producing and non-oil-producing nations). These regions often face inadequate labor absorption capacity, leading to a persistent and accelerating rise in unemployment. This trend has resulted in declining household incomes and living standards, along with an increase in poverty level and incidence (Jugurnath et al., 2016).

This study explores the long-term relationship between economic growth and unemployment in Saudi Arabia, focusing on the unique dynamics of the Saudi economy, which is heavily influenced by its oil wealth and economic diversification efforts. It aims to analyze how fluctuations in economic growth impact unemployment rates, particularly in the context of the country's Vision 2030 initiative, which seeks to reduce dependence on oil and promote sustainable economic development. Saudi Arabia has historically experienced periods of rapid economic growth driven by oil revenues, which have significantly shaped employment patterns in the country. However, the reliance on oil has created a dual economy, where a substantial portion of the labor force is employed in the public sector, while the private sector has struggled to absorb the growing workforce, particularly among young Saudis. This study will examine the correlation between economic growth and unemployment rates, particularly how periods of economic expansion, driven by rising oil prices or successful diversification efforts, influence job creation. Additionally, the analysis will consider several

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control variables that may impact the relationship between economic growth and unemployment. For instance, this study incorporates current account balance (% of GDP) as a control variable, since a positive current account balance indicates that a country exports more than it imports, contributing to economic stability and potential job creation. In Saudi Arabia, a strong current account position, often bolstered by oil exports, can lead to increased government spending and investment in infrastructure and services, thereby creating jobs and potentially reducing unemployment.

Furthermore, oil rents (% of GDP) are included as another control variable, as oil rents significantly influence the Saudi economy by providing substantial revenue to the government. High oil rents can enable increased public sector hiring and social spending, contributing to lower unemployment rates. However, over-reliance on oil rents may create vulnerabilities; fluctuations in oil prices can lead to economic instability and adversely impact employment levels when prices fall. In addition, School enrollment, tertiary (% gross), is also analyzed as a control variable, as higher tertiary school enrollment suggests a more educated workforce, enhancing productivity and innovation. In Saudi Arabia, investing in education can lead to better job opportunities for graduates, reducing unemployment among young Saudis. However, if the education system does not align with market needs, a mismatch may lead to higher unemployment rates among graduates.

Moreover, the study examines general government final consumption expenditure (% of GDP) as a control variable, given that increased government spending can stimulate economic activity and create jobs. In Saudi Arabia, government expenditure often funds infrastructure projects and public services, leading to job creation in various sectors. Conversely, reductions in government spending, particularly during economic downturns, could exacerbate unemployment. Furthermore, the analysis includes manufacturing value added (% of GDP) as a control variable, recognizing that a strong manufacturing sector can significantly impact job creation by employing a large number of workers. In Saudi Arabia, enhancing the manufacturing sector through diversification efforts could absorb excess labor from the public sector and help reduce unemployment rates. However, unemployment may persist if manufacturing does not grow in tandem with the labor force. Also, Services value added (% of GDP) is considered another control variable, as the services sector plays a vital role in modern economies, and its growth can lead to job creation in various fields such as finance, healthcare, and tourism. Expanding the services sector in Saudi Arabia as part of economic diversification can help alleviate unemployment, particularly among youth, who may find more opportunities in this area.

Finally, the study incorporates inflation (annual%) as a control variable, recognizing that inflation can have complex effects on unemployment. Moderate inflation may indicate a growing economy, which can lead to job creation, while high inflation can erode purchasing power, reduce consumer spending, and create uncertainty in the economy, potentially leading to higher unemployment. In Saudi Arabia, managing inflation is critical to maintaining economic stability and supporting employment growth.

This study employs the Vector Error Correction Model (VECM) approach to analyze the long-term relationship between GDP growth and unemployment in Saudi Arabia, while accounting for various control variables. The VECM is particularly suitable for this analysis as it allows for the examination of both short-term dynamics and long-term equilibrium relationships among the variables in the system. One of the key advantages of the VECM approach is its ability to handle non-stationary time series data that are cointegrated, ensuring that the relationships among the variables are accurately captured over time. Moreover, the VECM provides insights into how deviations from long-term equilibrium are corrected over time, highlighting the speed at which adjustments occur in response to shocks. This feature is crucial for understanding the responsiveness of unemployment to changes in GDP growth and other control variables. By incorporating both short-term and long-term effects, the VECM allows for a more comprehensive analysis of the relationship, providing valuable information on how economic fluctuations can impact labor markets. Additionally, the VECM framework facilitates the analysis of Granger causality, enabling the study to determine whether changes in GDP growth have a predictive effect on unemployment or if the relationship is bidirectional. This capability is essential for policymakers, as it helps identify key drivers of employment dynamics and informs strategic interventions. The VECM also allows for the inclusion of multiple control variables, providing a holistic view of the factors influencing unemployment in Saudi Arabia.

Furthermore, the VECM can accommodate structural breaks and changes in economic regimes, making it adaptable to the evolving economic landscape of Saudi Arabia, particularly in light of the ongoing diversification efforts under Vision 2030. Overall, using the VECM approach in this study enhances the robustness of the findings and provides a nuanced understanding of the complex interactions between GDP growth and unemployment, ultimately supporting more effective policy formulation to foster economic stability and job creation.

The remainder of the paper is organized as follows. Section two reviews the literature on the relationship between unemployment and GDP, establishing theoretical foundations and contextualizing the study within existing research. Section three outlines the methodology for data collection and analysis, detailing the examined variables, including GDP growth and unemployment rates, and the analytical framework utilized, specifically the VECM. Section four presents the

empirical findings, highlighting significant relationships between GDP growth, unemployment, and the service sector. Finally, the conclusion summarizes key insights and discusses implications for policymakers and future research directions.

2. Literature review

Over the past few decades, the literature has extensively examined the relationship between unemployment and economic growth, considering key concepts such as Okun's Law, labor market dynamics, and policy implications. Research has highlighted the intricate relationship between unemployment and economic growth in Arab nations. For example, Abdul-Khaliq et al. (2014) identified a negative correlation, suggesting that unemployment is inversely related to economic growth in nine Arab countries. Focusing specifically on Jordan, Hjazeen et al. (2021) found similar results, reinforcing the negative association between economic growth and unemployment. In contrast, Kreishan (2011) concluded that no significant relationship exists between unemployment and inflation. Various studies examining the linkages between unemployment and economic growth yield differing levels of support for Okun's Law across various regions (Efrianti et al., 2018). While evidence from Sri Lanka and Indonesia supports Okun's Law, Malaysia demonstrated a robust bidirectional relationship. Additionally, India exhibited a negative correlation between unemployment and economic growth, further contributing to the complex narrative of this relationship in different contexts.

Similarly, Jibir et al. (2015) examined the impact of unemployment on Nigeria's economic growth from 1982 to 2014. The study aimed to assess the relationship between unemployment and economic growth while determining the direction of causality. The results indicated a negative association between unemployment and real GDP, which serves as a proxy for economic growth, consistent with Okun's Law. Furthermore, the Granger causality test showed no significant causal relationship between unemployment and economic growth. The authors also suggested that improving skill acquisition and reforming the educational system could enable youth to become job creators rather than just job seekers. Whereas Chand et al. (2017) investigated the impact of economic growth on India's unemployment rate, using Gross Domestic Product (GDP) as a proxy for economic growth. Through correlation and regression analysis, the study examined the nature and extent of this influence. The findings revealed a significant negative correlation between economic growth and the unemployment rate, indicating that unemployment tended to decrease as GDP rose. Furthermore, the study showed that GDP accounted for 48% of the variation in the unemployment rate. These results were consistent with Okun's Law and aligned with other research in the field. For Eastern European countries, Soylu et al. (2018) investigated the relationship between economic growth and unemployment using annual time series data from 1992 to 2014. The researchers applied the Pooled Panel OLS and Panel Johansen Co-integration tests to analyze this relationship within the framework of Okun's Law. The findings revealed that economic growth negatively influenced unemployment, with a 1% increase in GDP leading to a 0.08% decrease in unemployment, reflecting Okun's coefficient for Eastern European countries. Additionally, the study found co-integration between these critical macroeconomic variables.

Likewise, for the eurozone, Altunöz (2021) examined the relationship between economic growth and unemployment in light of Okun's Law for the period 2000-2012, utilizing panel integration methods and panel error correction techniques. The study assessed several non-stationary panel root unit tests across all included countries to investigate unemployment hysteresis. The results indicated that Okun's Law holds valid for the eurozone, although the cointegration coefficient was found to be smaller than the Okun's coefficient observed for the United States and other developed countries, with the U.S. serving as a benchmark due to its status as the world's largest economy. Additionally, the study included developing countries in its analysis to compare the more volatile growth and unemployment dynamics in these nations with those in developed countries.

A number of studies have investigated the relationship between GDP growth and unemployment in Saudi Arabia. For instance, Louail and Riache (2019) investigated Okun's Law by examining the influence of the output gap on unemployment rates and the role of economic growth in reducing unemployment. They utilized the autoregressive distributed lag bounds testing method to assess the presence of Okun's Law in the Saudi economy from 1991 to 2017. The empirical results demonstrated that Okun's Law is applicable in this context. The computed coefficients using the Gap Version indicated that the gross domestic product gap has a negative and significant effect on unemployment rates, with a 1% increase in GDP associated with a 0.29% decrease in the unemployment rate. Similarly, Ahmed and Hassan (2020) analyzed the relationship between unemployment rates and economic growth in the Kingdom of Saudi Arabia from 1980 to 2018, focusing on the economic measures implemented by authorities to mitigate the negative effects of high unemployment rates. The study employed various analytical techniques, including the correlation matrix, Granger causality test, co-integration test, error correction model, and Okun's model. The findings revealed a strong relationship between economic growth and the unemployment rate during the sample period. In addition, Meteb (2017) analyzed the relationship between unemployment and economic growth in Saudi Arabia from 2000 to 2015, aiming to explain employment levels and their determinants. The study explored whether

recruitment relies on the public sector, the impact of public sector job creation on the private sector, and the adequacy of economic growth in reducing unemployment among Saudis. The findings of his study revealed a positive relationship between employment and real income, investment, government expenditure, and exports, while showing a negative relationship with imports. The study concluded that economic growth has been insufficient to lower the unemployment rate, highlighting a preference for government jobs over private sector employment. Al Yousif (2021) suggested boosting productivity in the non-oil private sector as a means to alleviate unemployment, whereas Alrasheedy (2019) assessed the substantial economic and social costs associated with unemployment, including a notable decline in GDP. Together, these studies highlight the necessity of tackling unemployment in Saudi Arabia through a multifaceted approach that includes economic diversification, productivity improvement, and targeted policy measures.

Amirat and Zaidi (2020) and Singh et al. (2022) emphasized the critical role of education, training, and knowledge-based activities in achieving sustainable development goals and fostering economic growth. Their findings suggest that investing in these sectors can lead to increased GDP growth and lower unemployment rates, as a well-educated and skilled workforce is essential for enhancing productivity and innovation. By equipping individuals with the necessary skills and knowledge, economies can create a more competitive labor market that benefits both employers and job seekers. This aligns with our selection of control variables, particularly school enrollment, which captures the level of educational attainment and access to higher education, directly influencing the quality of the labor force. Mensi et al. (2018) further underlined the significance of both public and private investments in driving economic growth, particularly highlighting how a rise in public investment positively impacts non-oil GDP in Saudi Arabia. This reflects our inclusion of government consumption expenditure as a control variable, which can affect overall economic activity and employment levels. Increased government spending can stimulate demand across various sectors, creating job opportunities and promoting economic stability. This is especially important in the context of Saudi Arabia, where the government plays a significant role in economic development.

Moreover, the contribution of the manufacturing and services sectors cannot be overlooked. A diversified economy that invests in manufacturing can provide numerous employment opportunities, reducing reliance on the oil sector and mitigating the impacts of oil price fluctuations. Increased investment in these sectors can lead to higher productivity, which is vital for achieving sustainable economic growth. This aligns with our inclusion of manufacturing value-added as a control variable, as it reflects the extent to which the manufacturing sector contributes to overall economic performance and job creation. The services sector also plays a crucial role in the Saudi economy, particularly as it continues to expand and diversify. By incorporating services value-added as a control variable, we can assess its impact on employment and GDP growth. A thriving services sector can generate jobs and provide essential support for other industries, fostering overall economic development. However, Meteb (2017) raised a crucial concern regarding the persistent unemployment rate in Saudi Arabia, which has not seen significant improvement despite economic growth. This disparity suggests that economic growth alone may not be sufficient to address unemployment issues, calling for a more nuanced understanding of labor market dynamics and the effectiveness of current policies. The incorporation of variables such as the current account balance and oil rents into our analysis is essential, as these factors can influence the economic environment and impact job creation. There is a pressing need for further research and targeted policy interventions to identify the underlying factors contributing to persistent unemployment and to develop strategies that effectively connect economic growth with job creation. This integrated approach should align educational outcomes with labor market demands and incentivize private sector involvement in job creation efforts, addressing the complex interplay between our selected control variables and the overarching relationship between GDP growth and unemployment.

This study differentiates itself from previous studies by incorporating a comprehensive set of control variables that address various dimensions of the labor market in Saudi Arabia. While many existing studies focus primarily on the relationship between GDP and unemployment, our research includes crucial factors such as the current account balance, oil rents, government expenditure, school enrollment, and the contributions of the manufacturing and services sectors. This approach allows for a more nuanced analysis of how these variables interact with economic growth, providing deeper insights into the complex dynamics influencing unemployment rates. By emphasizing the role of these additional control variables, our study enhances the understanding of labor market behavior in Saudi Arabia and offers valuable implications for policymakers aiming to reduce unemployment and foster sustainable economic development. Moreover, this study utilizes the VECM methodology, which sets it apart from prior research by enabling a thorough examination of both short-term dynamics and long-term equilibrium relationships among the selected variables. The VECM approach is particularly effective for analyzing non-stationary time series data, allowing us to investigate the adjustment mechanisms linking fluctuations in GDP to changes in unemployment over time. This methodological rigor strengthens the validity of our findings and contributes to the existing literature by providing robust empirical

evidence on the interconnections between economic growth and unemployment in Saudi Arabia. By combining an extensive set of control variables with the sophisticated VECM methodology, this study offers a unique perspective on labor market dynamics, underscoring the importance of comprehensive analyses in informing effective policy interventions.

3. Data and model specification

This study examines the long-term relationship between economic growth and unemployment in Saudi Arabia, utilizing annual time-series data spanning from 1991 to 2023.

The variables selected for this analysis include the unemployment rate, GDP, and a set of control variables: Current account balance, oil rents, government expenditure, school enrolment in tertiary education, manufacturing value-added, services value-added, and inflation. Table 1 provides a detailed description of these selected variables. The data are sourced from reliable institutions, including the Saudi Arabian Monetary Authority (SAMA), the World Bank, and other relevant databases.

Table 1: Variable descriptions

Variable	Description
GDP	GDP growth (annual %)
U	Unemployment, total (% of total labor force)
CAB	Current account balance (% of GDP)
OIR	Oil rents (% of GDP)
SE	School enrolment, tertiary (% gross)
GOVT	General government final consumption expenditure (% of GDP)
MANF	Manufacturing, value added (% of GDP)
SERV	Services, value added (% of GDP)
INF	Inflation, consumer prices (annual %)

Fig. 1 presents a scatterplot matrix, a visualization tool commonly used in statistics to explore relationships between multiple variables, where each cell represents the relationship between two variables. It shows that unemployment has a strong negative relationship with economic growth, current account balance, along other control variables.

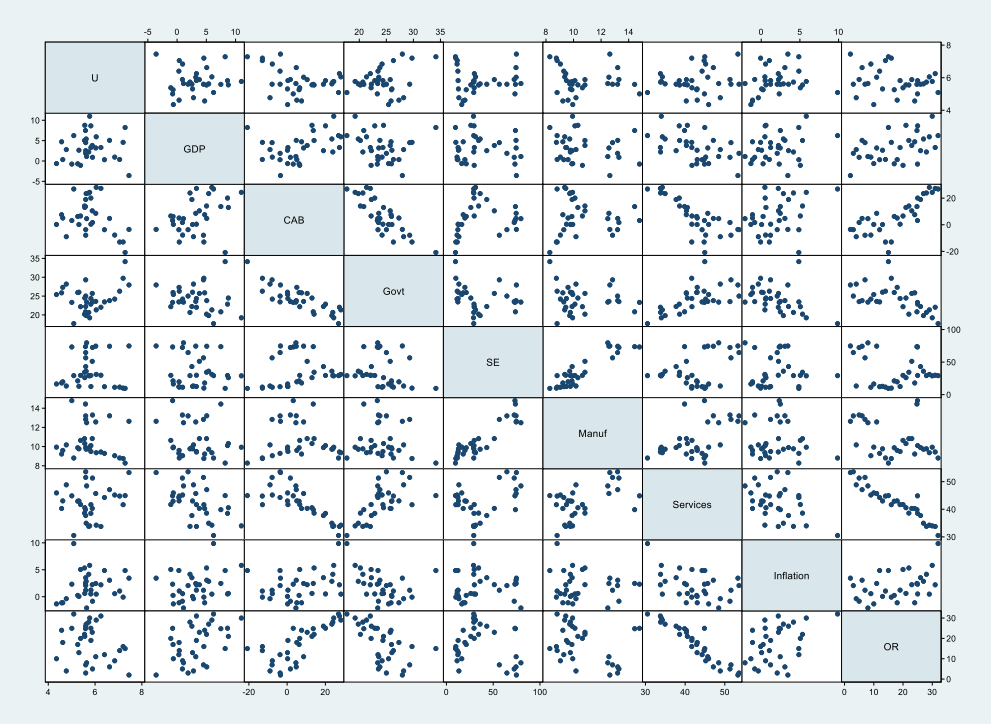

Fig. 1: Scatterplot matrix

3.1. Model specification

To analyze the relationship between unemployment and GDP growth in Saudi Arabia, this study employs the VECM methodology to explore the dynamic relationships between these variables. This approach is suitable given the non-stationary nature of the time series data and the potential for long-term equilibrium relationships among the variables. The VECM framework allows for the estimation of both short-term and long-term dynamics, providing a comprehensive understanding of how GDP and the selected control variables influence unemployment. The dynamic nature of the econometric model is represented in the Vector Autoregression (VAR) form as follows:

$$Z_t=\tau_0+\sum_{i=1}^{n}\tau_{1i}\,Z_{t-i}+\sum_{i=0}^{n}\tau_{ti}\,X_{t-i}+\emptyset_0 D_t+\varepsilon_t \quad (1)$$

where, Z_t represents the vector of endogenous variables at time t, while X_{t-i} denotes the set of explanatory variables, including their lagged values, incorporated into the model. These variables include the unemployment rate, Gross Domestic Product, current account balance (as a percentage of GDP), the oil rents measured as a percentage of GDP, government expenditure (as a percentage of GDP), tertiary education school enrollment expressed as a percentage of gross enrollment, manufacturing value-added (as a percentage of GDP), services value-added (as a percentage of GDP), and the annual inflation rate. D_t is the dummy variable for any structural breaks, whereas ε_t is the white noise term. The model given in Eq. 1 shows the long-term relationship; therefore to capture the short-run dynamics, we specify the VECM as follows;

$$\Delta Z_t = \beta D_t + \sum_{i=1}^{k-1} \omega_i \Delta X_{t-i} + \theta X_{t-1} + \omega_{k-1} X_{t-k+1} + \pi_t \quad (2)$$

where, $\omega = \alpha.\beta'$ and ω is decomposed into two matrices of dimensions $(n\ x\ r)$, r is the number of cointegrating vectors, α is a matrix of adjustment coefficients containing the short-run dynamics, whereas β contains the long-run coefficients.

The control variables in this study are integral to understanding their linkages with unemployment in Saudi Arabia. The current account balance (CAB_t)reflects the economy's external stability, where a positive balance can stimulate job creation through increased investment. Oil rents (OR_t) as a percentage of GDP significantly influences employment due to the dominance of the oil sector in Saudi Arabia's economy, often impacting job availability in related industries. Government expenditure ($GOVT_t$) can directly reduce unemployment by financing infrastructure and social programs that generate jobs. Higher tertiary school enrollment (SE_t) enhances workforce skills, potentially reducing unemployment in the long term. Manufacturing value-added ($MANF_t$) and services value-added ($SERV_t$) represent sectoral contributions to the economy, where growth in these sectors typically correlates with increased employment opportunities. Lastly, inflation (INF_t) can indirectly affect unemployment, as rising prices might erode purchasing power and influence labor market dynamics through wage adjustments.

4. Results and analysis

We start our analysis by discussing the descriptive statistics of our selected variables, as presented in Table 2. The unemployment rate averages 6.41% with moderate variability. GDP growth ranges from -3.58% to 10.99%, reflecting economic fluctuations. The current account balance shows a wide range, averaging 12.94%, while oil rents (16.03% of GDP) highlight Saudi Arabia's oil dependency. Government expenditure and tertiary education enrollment average 23.38% and 22.37%, respectively. Manufacturing and services value-added indicate sectoral contributions, with means of 10.65% and 41.02%. Inflation remains low on average (1.99%) but shows variability, ranging from -2.09% to 9.87%.

Table 2: Descriptive statistics

Variable	Observation	Mean	SD	Min	Max
GDP	33	3.291	3.316	-3.582	10.994
U	33	5.794	.774	4.35	7.45
CAB	33	6.407	12.935	-20.805	28.125
SE	33	36.718	23.93	9.698	79.613
GOVT	33	24.251	3.379	17.704	34.155
MANF	33	10.649	1.772	8.283	14.788
SERV	33	42.46	5.906	30.512	53.594
INF	33	1.99	2.55	-2.093	9.87
OIR	33	16.03	9.619	1	32

Table 3 presents the pairwise correlation between various economic variables. A strong negative correlation between unemployment and GDP (-0.782**) suggests that higher unemployment is associated with reduced economic output, aligning with the broader understanding of the inverse relationship between these two metrics. Unemployment has a moderate negative correlation with the current account balance (CAB) (-0.331*), indicating that increased unemployment may slightly coincide with a deterioration in trade performance. The correlation with student enrolments (SE) is moderately negative (-0.644**), suggesting that higher unemployment may be associated with decreased enrolment, possibly due to reduced affordability or prioritization of education during economic downturns. while it is strongly negative with the services sector (SERV) (-0.859***), suggesting that rising unemployment is closely tied to declines in service-oriented activities. A significant negative correlation with government spending (-0.683**) may reflect a tendency for fiscal tightening during higher unemployment periods or a lag in stimulus effectiveness. In contrast, unemployment's positive correlation with manufacturing (MANF) (0.592***) raises concerns about structural mismatches, where manufacturing growth does not proportionally translate into employment. The relationship with inflation (-0.794**) is strongly negative, aligning with theoretical insights like the Phillips Curve, where higher unemployment may correspond to lower inflation rates. Additionally, unemployment has a strong negative correlation with the official interest rate (OIR) (-0.812***), highlighting the potential role of accommodative monetary policy during elevated unemployment. These correlations collectively reflect the intricate interdependencies among

economic indicators, emphasizing the multifaceted nature of unemployment's relationship with broader economic conditions.

Stationarity is a critical property in time series analysis as it ensures that the statistical properties of a dataset, such as mean, variance, and autocorrelation, remain constant over time. This property is essential for reliable estimation, hypothesis testing, and forecasting, as non-stationary data can lead to spurious results. The Augmented Dickey-Fuller (ADF) test results in Table 4 indicate stationarity of variables at different levels of differencing. At the level form, only GDP and government spending (GOVT) are significant, whereas upon first differencing, all variables become stationary, suggesting that the variables are integrated of order one, requiring differencing to achieve stationarity.

Table 3: Pairwise correlations

Variables	(GDP)	(U)	(CAB)	(SE)	(GOVT)	(MANF)	(SERV)	(INF)	(OIR)
GDP	1.000								
U	-0.782**	1.000							
CAB	0.372**	-0.331*	1.000						
SE	-0.123	-0.644**	0.138	1.000					
GOVT	-0.196	-0.683**	-0.832***	-0.204	1.000				
MANF	-0.180	0.592***	-0.045	0.911***	-0.098	1.000			
SERV	-0.508***	-0.859***	-0.780***	0.374**	0.619***	0.517***	1.000		
INF	0.250	-0.794**	0.319*	0.029	-0.423**	-0.083	-0.426**	1.000	
OIR	0.445***	-0.812***	0.696***	-0.464***	-0.443***	-0.674***	-0.881***	0.343*	1.000

***: p<0.01; **: p<0.05; *: p<0.1

Table 4: ADF unit roots test

Variables	P-value	P-value
	Level	1st difference
CAB	0.4983	0.0009
GDP	0.0028	0.0136
GOVT	0.0728	0.0006
INF	0.0568	0
MANF	0.7488	0.0025
OIR	0.6206	0.0006
SERV	0.4222	0.0005
U	0.3901	0.0027

Table 5 presents the Johansen test to identify the presence of cointegrating relationships among variables using trace statistics and critical values at the 5% significance level. The test starts with zero ranks (no cointegration) and increases the rank incrementally. Cointegration is observed at a maximum rank of five, as indicated by the trace statistic (29.8273), which falls below the critical value (34.55). Beyond this rank, the test statistics fail to reject the null hypothesis, suggesting no further cointegrating relationships. This result implies that five long-term equilibrium relationships exist among the variables, which is critical for understanding their interdependence.

Table 5: Johansen tests for Cointegration

Maximum rank	Params	Log-likelihood	Eigenvalue value	Trace statistic	Critical value 5%
0	80	-447.003	.	386.3275	170.8
1	95	-381.665	0.98523	255.6531	136.61
2	108	-338.897	0.93666	170.1167	104.94
3	119	-303.293	0.89945	98.908	77.74
4	128	-281.345	0.75732	55.0118	54.64
5	135	-268.752	0.55621	29.8273	34.55
6	140	-261.732	0.36425	15.7858	18.17
7	143	-257.258	0.25073	6.8373	3.74
8	144	-253.839	0.19793	.	.

In estimating a Vector Error Correction (VEC) model, selecting lags is crucial as it captures the dynamic relationships among the variables while ensuring that the model is properly specified to account for cointegration among the integrated series. The optimal lag length enhances the model's predictive accuracy and interpretability, ensuring valid inferences can be drawn from the estimated relationships.

Table 6 presents the lag-order selection criteria for a time series model. Lag 0 is a baseline with a log-likelihood of -638.737 and the highest AIC, HQIC, and SBIC values, indicating a poor fit. Lag 1 shows a significant improvement, with a log-likelihood of -429.423 and an LR statistic of 418.63 (p=0), suggesting that adding this lag significantly enhances the model. Lag 2 further improves the log-likelihood to -243.126, with an LR statistic of 372.59 (significant) and the lowest FPE and AIC values, indicating that this model provides the best balance of fit and complexity. Thus, Lag 2 is recommended as the optimal choice for the model.

Table 7 presents the long-term results from the VECM, highlighting the relationships between unemployment and key macroeconomic variables in Saudi Arabia. GDP (−0.396-0.396−0.396) has a significant and negative coefficient, indicating that economic growth is associated with reduced

unemployment in the long run, consistent with Okun's Law. The current account balance (−0.028-0.028−0.028), school enrollment (−0.218-0.218−0.218), government expenditure (−0.560-0.560−0.560), inflation (−0.177-0.177−0.177), and oil rents (−0.379-0.379−0.379) all exhibit significant negative relationships with unemployment, underscoring their roles in mitigating unemployment over time. These findings suggest that improved fiscal policies, higher education levels, and a robust non-oil economy can substantially lower unemployment. The services sector (−0.134-0.134−0.134) also shows a significant negative relationship, reflecting its potential to create jobs as the economy diversifies. However, manufacturing (0.6340.6340.634) has a significant positive relationship with unemployment, potentially pointing to challenges such as labor market mismatches or automation impacting job availability in this sector.

Table 6: Lag-order selection criteria

Lag	Log-likelihood	Likelihood ratio	df	p	FPE	AIC	HQIC	SBIC
0	-638.737	.	.	.	1.10E+07	41.7895	41.9252	42.2058
1	-429.423	418.63	81	0	3587.62	33.5111	34.8682	37.6743
2	-243.126	372.59*	81	0	19.8599*	26.7178*	29.2963*	34.6279*

*: The lag order selected by the respective criterion (minimum value)

Table 7: Long term relations

	Coefficient	Standard error	z	P>|z|
U	1	.	.	.
GDP	- 0.396345	0.030554	- 12.97	0
CAB	-0.02763	0.01345	-2.05	0.04
SE	-0.21824	0.008222	-26.54	0
GOVT	-0.56002	0.052069	-10.76	0
MANF	0.634101	0.156758	4.05	0
SERV	-0.13401	0.05567	-2.68	0.077
INF	-0.17712	0.037946	-4.67	0
OIR	-0.37904	0.033359	-11.36	0
Time trend	0.305109	.	.	.
Constant term	15.29266	.	.	.

Table 8 presents the dynamics of the short-term relationship, and the estimates reveal the immediate adjustments following shocks to the system. The error correction term (-0.201) is significant and negative, indicating that approximately 20% of deviations from the long-term equilibrium are corrected each period, suggesting moderate adjustment speeds. This implies that the system exhibits a reasonable capacity to return to equilibrium after experiencing shocks. GDP (-0.062) and the current account balance (-0.098) have negative coefficients in the short term, indicating that both variables contribute to reducing unemployment in the immediate aftermath of economic changes. Government expenditure (-0.073), manufacturing (-0.535), and oil rents (-0.057) also exhibit significant short-term reductions in unemployment, highlighting their stabilizing roles during economic fluctuations. These findings suggest that fiscal policies and industrial activities can play a crucial role in mitigating unemployment in response to economic shocks. The services sector (-0.291) has a strong short-term negative impact, suggesting its immediate job creation potential, reinforcing the importance of service-oriented industries in the labor market. Conversely, inflation (-0.112) reduces unemployment in the short term, aligning with the Phillips curve dynamics, which posit an inverse relationship between inflation and unemployment in the short run.

Overall, these results emphasize the complex interplay between various economic factors and their immediate effects on unemployment, illustrating the importance of policy measures that target these areas to stabilize the labor market during periods of economic turbulence.

Table 8: Short term relationship dynamics

Variables	Standard error	z	P>|z|
Error correction term	-0.201034	0.063126	-3.18
U LD.	-0.149753	0.186554	-0.8
GDP LD.	0.0620693	0.025036	2.48
CAB LD.	0.0984845	0.051024	1.93
SE LD.	0.0077298	0.026096	0.3
GOVT LD.	-0.073544	0.05431	-1.35
MANF LD.	-0.534581	0.151427	-3.53
SERV LD.	0.2914372	0.081302	3.58
INF LD.	-0.111626	0.031515	-3.54
OIR LD.	0.0173796	0.024997	0.7
Time trend	0.0126042	0.009045	1.39
Constant	-0.393847	0.172246	-2.29

The findings from Tables 7 and 8 reveal a complex relationship between unemployment and key macroeconomic variables in Saudi Arabia, both in the long and short term. Long-term results indicate that economic growth, current account balance, school enrollment, government expenditure, inflation, oil rents, and the services sector all negatively impact unemployment,

supporting the notion that improved fiscal policies and a diversified economy can reduce unemployment. In contrast, manufacturing is positively related to unemployment, suggesting potential challenges in the labor market. Short-term dynamics show that around 20% of deviations from long-term equilibrium are corrected each period, with economic growth and the current account balance also contributing to immediate reductions in unemployment. These findings highlight the need for targeted policy measures to stabilize the labor market and address unemployment effectively.

5. Conclusion

This research aimed to investigate the relationship between unemployment and key macroeconomic variables in Saudi Arabia, focusing on the period from 1991 to 2023. The study examined various variables, including GDP, current account balance, school enrollment, government expenditure, inflation, oil rents, and the performance of the manufacturing and services sectors. Using a VECM methodology, the research analyzed both long-term and short-term dynamics to understand how these factors influence unemployment. The results indicated significant long-term relationships with economic growth, current account balance, education levels, government expenditure, inflation, oil rents, and the services sector, all negatively associated with unemployment, consistent with Okun's Law. Specifically, a rise in GDP corresponds to a reduction in unemployment, highlighting the importance of sustainable economic growth as a driver for job creation. Similarly, improvements in the current account balance suggest a stronger economic position that can facilitate employment opportunities. Education levels, as indicated by school enrollment, play a crucial role in enhancing the employability of the workforce, thus contributing to lower unemployment rates. Furthermore, government expenditure emerges as a vital component in stimulating economic activity and job creation, emphasizing the need for effective fiscal policies. Conversely, the manufacturing sector displayed a positive relationship with unemployment, indicating potential challenges such as labor market mismatches or automation, which could hinder job availability in this sector. This suggests a need for policies that support skills development and retraining to align workforce capabilities with industry demands.

In the short term, the analysis revealed that approximately 20% of deviations from long-term equilibrium are corrected each period, indicating moderate adjustment speeds within the labor market. Both GDP and the current account balance negatively affect unemployment in the immediate aftermath of economic changes, demonstrating that economic fluctuations can rapidly influence labor market conditions. Additionally, government expenditure, manufacturing, and oil rents contribute to short-term reductions in unemployment, underscoring their stabilizing roles during economic fluctuations. The strong short-term negative impact of the services sector further highlights its immediate job creation potential, reinforcing the importance of service-oriented industries in the labor market. Moreover, inflation's inverse relationship with unemployment in the short run aligns with Phillips curve dynamics, suggesting that higher inflation can temporarily reduce unemployment. However, this finding also raises concerns about the sustainability of such effects and the need to monitor inflationary pressures carefully.

Overall, this research provides insights into the complex relationship between unemployment and key macroeconomic variables in Saudi Arabia, emphasizing the importance of targeted policy measures to address labor market challenges. The findings highlight that promoting sustainable economic growth through investments in infrastructure and innovation is essential for job creation. Additionally, enhancing educational opportunities and skills training is critical to ensure the workforce is equipped to meet the demands of a dynamic labor market. The research highlights the need for fiscal policies prioritizing public expenditure on employment-generating initiatives, particularly in the services sector, which is vital in mitigating unemployment. Furthermore, it emphasizes the necessity of monitoring inflation and its impact on unemployment to maintain economic stability. By implementing these strategies, policymakers can effectively reduce unemployment and foster a more resilient economy in Saudi Arabia.

List of abbreviations

ADF	Augmented Dickey-Fuller test
AIC	Akaike information criterion
CAB	Current account balance
df	Degrees of freedom
FPE	Final prediction error
GDP	Gross domestic product
GOVT	Government final consumption expenditure
HQIC	Hannan–Quinn information criterion
INF	Inflation, consumer prices
LD	Lagged difference (used in variable notation, e.g., GDP LD)
LR	Likelihood ratio
MANF	Manufacturing value added
OIR	Oil rents
SBIC	Schwarz Bayesian information criterion
SD	Standard deviation
SE	School enrollment, tertiary
SERV	Services value added
U	Unemployment
VAR	Vector autoregression
VECM	Vector error correction model

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Abdul-Khaliq S, Soufan T, and Shihab RA (2014). The relationship between unemployment and economic growth rate in Arab country. Journal of Economics and Sustainable Development, 5(9): 56-59.

Ahmed M and Hassan M (2020). Real unemployment in Balochistan, Pakistan: Context, issues and way forward. Pakistan Vision, 21(2): 55-74.

Al Yousif MA (2021). Alternative view of unemployment issue among Saudi citizens-automatization of local gas stations as a case study. Business and Economic Research, 11(3): 132-150. https://doi.org/10.5296/ber.v11i3.18781

Alrasheedy A (2019). The cost of unemployment in Saudi Arabia. International Journal of Economics and Finance, 11(11): 1-30. https://doi.org/10.5539/ijef.v11n11p30

Altunöz U (2021). Theoretical and empirical analysis of growth, poverty and inequality in emerging and transition economies. Fiscaoeconomia, 5(3): 1028-1051. https://doi.org/10.25295/fsecon.975325

Amirat A and Zaidi M (2020). Estimating GDP growth in Saudi Arabia under the government's Vision 2030: A knowledge-based economy approach. Journal of the Knowledge Economy, 11(3): 1145-1170. https://doi.org/10.1007/s13132-019-00596-2

Chand K, Tiwari R, and Phuyal M (2017). Economic growth and unemployment rate: An empirical study of Indian economy. Pragati: Journal of Indian Economy, 4(2): 130-137. https://doi.org/10.17492/pragati.v4i02.11468

Efrianti R, Marwa T, Tarmizi N, and Yuliana S (2018). Growth, unemployment and its implication on poverty: Empirical study in districts/cities of South Sumatera province. Eurasian Journal of Economics and Finance, 6(4): 27-37. https://doi.org/10.15604/ejef.2018.06.04.003

Hjazeen H, Seraj M, and Ozdeser H (2021). The nexus between the economic growth and unemployment in Jordan. Future Business Journal, 7: 42. https://doi.org/10.1186/s43093-021-00088-3

Jibir A, Bappayaya B, and Babayo H (2015). Re-examination of the impact of unemployment on economic growth of Nigeria: An econometric approach. Journal of Economics and Sustainable Development, 6(8): 116-123.

Jugurnath B, Chuckun N, and Fauzel S (2016). Foreign direct investment and economic growth in Sub-Saharan Africa: An empirical study. Theoretical Economics Letters, 6(4): 798-807. https://doi.org/10.4236/tel.2016.64084

Kreishan FM (2011). Economic growth and unemployment: An empirical analysis. Journal of Social Sciences, 7(2): 228-231. https://doi.org/10.3844/jssp.2011.228.231

Louail B and Riache S (2019). Asymmetry relationship between economic growth and unemployment rates in the Saudi economy: Application of Okun's law during the period. International Journal of Advanced and Applied Sciences, 6(10): 83-88. https://doi.org/10.21833/ijaas.2019.10.013

Mensi W, Shahzad SJH, Hammoudeh S, and Al-Yahyaee KH (2018). Asymmetric impacts of public and private investments on the non-oil GDP of Saudi Arabia. International Economics, 156: 15-30. https://doi.org/10.1016/j.inteco.2017.10.003

Meteb AM (2017). Unemployment and economic growth in Saudi Arabia 2000-2015. International Journal of Economics and Finance, 9(9): 83-93. https://doi.org/10.5539/ijef.v9n9p83

Saani MR, Abdulai AM, and Salifu M (2023). Unemployment and remittances nexus in Ghana: The gender perspective. Cogent Economics and Finance, 11(2): 2243068. https://doi.org/10.1080/23322039.2023.2243068

Singh HP, Singh A, Alam F, and Agrawal V (2022). Impact of sustainable development goals on economic growth in Saudi Arabia: Role of education and training. Sustainability, 14(21): 14119. https://doi.org/10.3390/su142114119

Soylu ÖB, Çakmak İ, and Okur F (2018). Economic growth and unemployment issue: Panel data analysis in Eastern European countries. Journal of International Studies, 11(1): 93-107. https://doi.org/10.14254/2071-8330.2018/11-1/7