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Macroeconomic dynamics and interdependencies in the MENA region: An MS-VAR analysis

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Abstract

In my paper, I examine the macroeconomic dynamics of MENA countries from 1980 to 2022. I utilize the Markov-Switching Vector Autoregressive (MS-VAR) model to analyze the behavior and economic interdependencies of these economies across different states. The results indicate a significant degree of dependence within the region, particularly among North African economies (Algeria, Tunisia, Morocco) and Gulf nations (Saudi Arabia, Bahrain, United Arab Emirates). Both static and dynamic analyses reveal that Saudi Arabia and Egypt are key players in regional economic fluctuations, influencing trade, investment, and the synchronization of business cycles. The findings also demonstrate high volatility in countries such as Iraq and Syria, reflecting instability, while others, like Bahrain and Jordan, exhibit more stable economic transitions. This study underscores the importance of economic integration and policy coordination in promoting regional stability and sustainable growth within the MENA region.

Keywords: Business cycle, Macroeconomic policies, Multivariate Markov switching.

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1. Introduction

The MENA (Middle East and North Africa) region occupies a crucial position on the world economic stage, thanks to its vast natural resources, geopolitical importance and economic diversity. However, despite its potential, the region faces persistent challenges in terms of economic stability and growth. Macroeconomic fluctuations in MENA countries are often influenced by a complex combination of internal and external factors, ranging from political and social shocks to fluctuations in commodity prices and changes in global economic conditions. This study aims to understand the transmission of economic shocks in the MENA region.

Limited research concerned the MENA regions which have the direction to analyze the MENA business cycle. Hirata, et al. [1] have analyzed the impact of global integration on the dynamics of business cycles in MENA regions. Neaime and Gaysset [2] used a SVAR model to examine Macroeconomic and monetary policy post Covid 19 in the MENA region. Using the GVAR model, Cashin, et al. [3] have studied the macroeconomic shocks in the industrial economies such as

China, the Euro Area and the USA to the MENA region. Graham, et al. [4] have examined the financial co-movement of selected MENA region from the period 2002 to 2010. More recently Saba, et al. [5] use a panel vector autoregression (PVAR) model to analyse the relationship between information and communication technology (ICT) diffusion, economic growth, and human development index (HDI) in the MENA, Sub-Saharan Africa (SSA), and Latin America and the Caribbean (LAAC) regions.

In this study, I look at macroeconomic fluctuations in MENA countries using the MS-VAR model (Markov-Switching Vector Autoregressive Model) developped by Hirata, et al. [1]. A sophisticated econometric method for capturing nonlinear dynamics and regime shifts. This approach is particularly relevant for analyzing the complex interactions among the region's economies, as it allows us not only to examine interdependence, but also to identify periods of economic growth or decline. The MS-VAR model is able to account for the alternative states that the economy can go through, providing a more nuanced view of economic reality. In a sequence of papers, Krolzig [6] has studied the statistical analysis of the MS-VAR models and their application to dynamic multivariate systems (Krolzig [6], Krolzig [7] and Krolzig, et al. [8], Krolzig [9]).

The objective of this research is to quantify the synchronization of GDP growth rates within MENA countries and to assess how these economies interact over time. Using reliable macroeconomic data, I will analyse not only the interactions between countries, but also the phases of economic growth and decline that may occur.

The paper is organized as follows. Section 2 provides the empirical strategy which describes the various specifications of MS-VAR model and the estimation process via EM algorithm. Section 3 introduces the empirical framework. The final section concludes.

2. Empirical Strategy

Analysing the synchronization of GDP growth rates across economies requires a rigorous empirical strategy. First, I need to collect reliable macroeconomic data on GDP growth rates for the countries under study. Second, I will treat synchronization statically through a simple reading of the correlation coefficient and analysis of the figures presented. Finally, econometric development based on the MS-VAR model is interesting to evaluate the synchronization. A presentation of the model follows.

The MS-VAR model, or Markov Regime VAR model, represents a significant advance in time series analysis by integrating regime-switching dynamics into vector autoregressive models. Unlike the classical VAR model, which assumes linear, time-invariant relationships between several economic variables, MS-VAR allows modelling of more complex economic behaviour, taking into account structural changes and discrete transitions between different states or regimes.

This approach is particularly useful in contexts where relationships between variables may evolve according to economic conditions, such as periods of growth and recession. By capturing these transitions through a Markov process, MS-VAR provides a better understanding of the underlying mechanisms that influence economic fluctuations. As a result, the model is widely used in both academic research and economic policy analysis, enabling decision makers to better anticipate the potential impact of economic change and adjust their strategies accordingly. In short, the MS-VAR model is a valuable tool for understanding the complexity of today's economic dynamics.

The MS-VAR model takes the following expression:

$$\boldsymbol{Y_t = A(s_t)Y_{t-1} + \varepsilon_t} \quad (1)$$

Where Y_t is a vector of observed variables, $A(s_t)$ is a coefficients matrix that depends on the current state s_t (the regime), and ε_t is an error term.

Regime dynamics are modelled by a Markov process, which means that the probability of a regime change depends only on the current regime. The transition probabilities can be written in a transition matrix:

$$P\{s_t = j | s_{t-1} = i,\ s_{t-2} = k, \ldots\} = P\{s_t = j | s_{t-1} = i\} = p_{ij} \quad (2)$$

Where p_{ij} gives the probability that state *i* will be followed by state *j*.

The MSVAR model parameters are typically estimated using the Expectation-Maximization (EM) algorithm or Monte Carlo techniques because the model contains hidden components that make direct estimation difficult.

3. Empirical Finding

The database consists of annual real GDP growth rate collected from the International Monetary Fund database[1] and covers the period 1980:2022. The database includes the following countries: Algeria (ALG), Bahrain (BAH), Egypt (EGY), Iran (IRAN), Iraq (IRAQ), Jordan (JOR), Morocco (MOR), Oman (OMAN), Saudi Arabia (SA), Syrian (SYR), Tunisia (TUN) and United Arab Emirates (UEA). The Figure 1 presents an illustration.

[1] http://www.imf.org/external/datamapper/

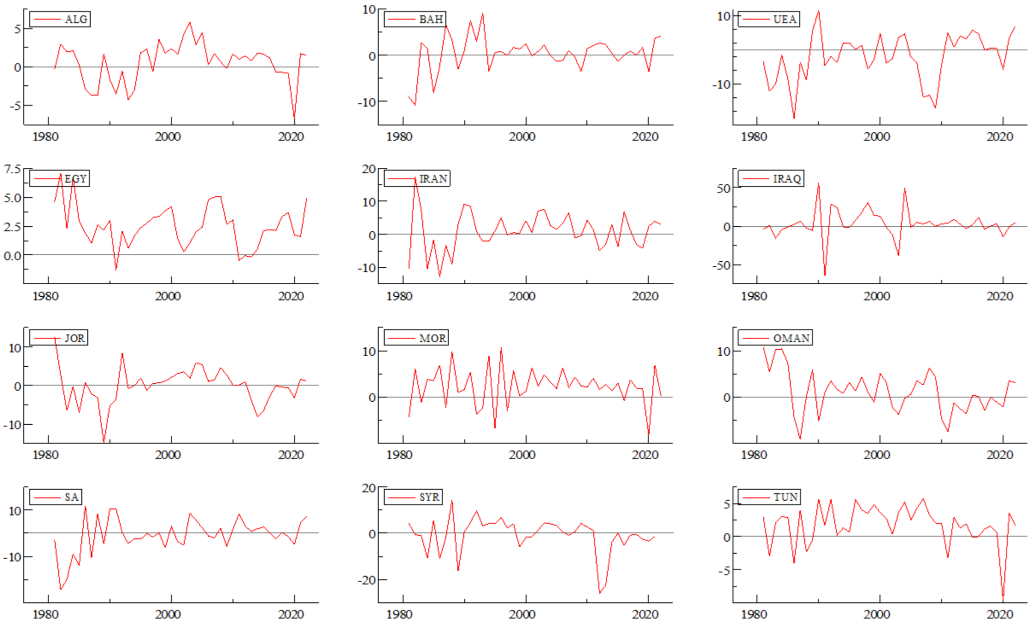

Figure 1.
The Real GDP growth rate of different economies (1981:2022).

As a first reading of the Figure, I can see some similar cycles between the fluctuation of Tunisian, Algerian and Morocco real GDP growth rate characterized by a perturbation between 1980 and 1990, then slight growth after 2010 and depression in 2020. A similar pattern can be observed between the business cycles of Oman and the United Arab Emirates economies. Marked by a depression in the 1990s and then stagnant growth until 2005, both countries experienced a depression before recovering in the late 2010s. What's more, both countries were not affected by the 2019 crisis. Another similar fluctuation can be observed, the case of Saudi Arabia and Bahrain, which is characterized by a phase of expansion between 1980 - 1992, then a stabilization of the movement until 2020. It should be noted that most economies experienced a period of depression in the 1990s and 2020. To effectively illustrate and summarize our in-depth analysis of economic fluctuations across various countries in the MENA region, I calculated the correlation coefficients among the examined economies. The results of these calculations are presented in Table 1.

Table 1.
The correlation coefficients.

	ALG	BAH	UEA	EGY	IRAN	IRAQ	JOR	MOR	OMAN	SA	SYR	TUN
ALG	1	-0.264	0.285	-0.016	0.409	0.282	-0.144	0.47	0.055	-0.075	0.285	0.39
BAH	-0.264	1	0.197	0.179	-0.198	0.055	-0.088	-0.399	-0.015	-0.199	-0.015	0.267
UEA	0.285	0.197	1	0.187	0.316	0.339	-0.315	-0.223	0.118	-0.082	0.196	0.028
EGY	-0.016	0.179	0.187	1	-0.075	0.358	-0.087	-0.119	0.456	0.309	0.038	0.401
IRAN	0.409	-0.199	0.316	-0.076	1	-0.415	-0.491	0.038	-0.024	-0.166	0.346	-0.144
IRAQ	0.282	0.056	0.339	0.358	-0.415	1	0.334	-0.266	0.123	0.107	0.113	0.292
JOR	-0.144	-0.088	-0.315	-0.087	-0.491	0.334	1	-0.055	-0.406	0.332	0.126	0.104
MOR	0.47	-0.399	-0.223	-0.119	0.038	-0.266	-0.055	1	-0.002	0.238	-0.06	0.319
OMAN	0.053	-0.012	0.118	0.459	-0.024	0.126	-0.409	-0.002	1	-0.482	-0.011	0.202
SA	-0.073	-0.195	-0.081	0.309	-0.162	0.107	0.337	0.238	-0.482	1	-0.271	-0.127
SYR	0.285	-0.015	0.197	0.038	0.347	0.113	0.126	-0.06	-0.014	-0.271	1	0.492
TUN	0.39	0.267	0.028	0.401	-0.144	0.292	0.104	0.319	0.202	-0.127	0.491	1

Looking at the table of correlation coefficients, it emerges that the real GDP fluctuation of Algeria, Morocco and Tunisia show notable similarities, with correlation coefficient of 40%. This highlights the fluctuations in the real GDP growth rates of these countries, marked by a disruption The most values are found in the Algeria GDP growth rate which coincided with 47% in Morocco and 40% in Tunisia. The SA coincide with 34% with the Jordan and 31% with Egypt. Moreover, the Table 1 shows a certain degree of desynchronization between the GDP growth rate of the same Gulf countries.

After this static reading, I will study the phenomenon in a dynamics analysis. Therefore, I introduce the econometric analysis by focusing on the Markov switching model widely used in empirical macroeconomics. Following Hirata, et al. [1], I'll try to see the synchronization and correlation between economies in a dynamic way by treating the problem with the Markov switching model. I try to study the effect and impact of the GDP growth rate of different economies in both recession and expansion regimes.

The equation to be estimated is done in the following regression:

$$GDP_{ALG,t} = \vartheta(s_t) + \sum_{i=1}^{p} \varphi_{1,i}(s_t)GDP_{ALG,t-i} + \sum_{i=1}^{p} \varphi_{2,i}(s_t)GDP_{BAH,t-i} + \sum_{i=1}^{p} \varphi_{3,i}(s_t)GDP_{UEA,t-i} + \sum_{i=1}^{p} \varphi_{4,i}(s_t)GDP_{EGY,t-i} + \sum_{i=1}^{p} \varphi_{5,i}(s_t)GDP_{IRAN,t-i} + \sum_{i=1}^{p} \varphi_{6,i}(s_t)GDP_{IRAQ,t-i} + \varphi_7 \sum_{i=1}^{p} \varphi_{7,i}(s_t)GDP_{JOR,t-i} + \sum_{i=1}^{p} \varphi_{8,i}(s_t)GDP_{MOR,t-i} + \sum_{i=1}^{p} \varphi_{9,i}(s_t)GDP_{OMAN,t-i} + \sum_{i=1}^{p} \varphi_{10,i}(s_t)GDP_{SA,t-i} + \sum_{i=1}^{p} \varphi_{11,i}(s_t)GDP_{SYR,t-i} + \sum_{i=1}^{p} \varphi_{12,i}(s_t)GDP_{TUN,t-i} + \varepsilon_t \quad (1)$$

The equation focuses on examining the impact of the growth rate of different economies on that of Algeria's economic growth. I rewrote this Equation 12 times, corresponding to the number of economies under analysis, to evaluate the interactions between the GDP growth rate of all the other economies studied.

The estimation results of the different Markov-switching dynamic models in the first and second regimes are reported in Figure 2 and Table 2. Figure 2 schematically presents the results of the MS-VAR model estimation, highlighting the identification of different regimes: regime 0 for certain economies and regime 1 for other economic situations. This distinction is based on the initial state that the economy experiences, which helps to better understand the various behaviors observed in these different contexts. The figure also illustrates the characteristics of the model's adjustment, emphasizing how economic variables respond in each regime, as well as the forecasts obtained for one step ahead. Meanwhile, Table 2 provides details on the estimated parametric data for our model. This data is essential for understanding the relationships between the different variables and evaluating the robustness of our results. By presenting both the visual results in Figure 2 and the detailed information in Table 2, 1 offer a coherent and in-depth overview of the economic dynamics captured by our model.

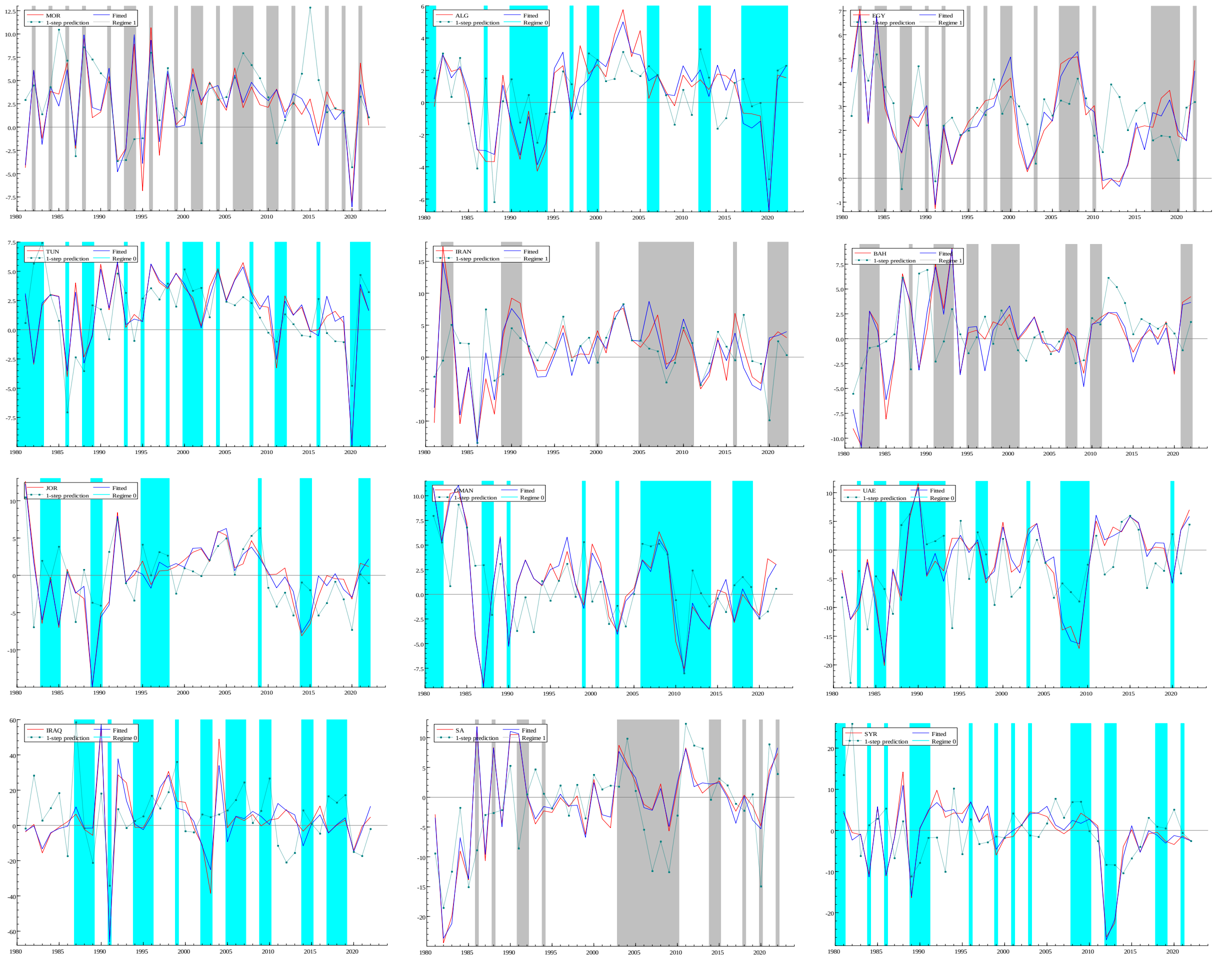

Figure 2.
The MS-VAR fitted model and regime probability detected.

Figure 2 provides a visual representation of the ability of the MS-VAR model to fit the data and simulate changes in economic regimes over time. Preliminary results suggest that the MS-VAR model shows promise in capturing the dynamics of regime changes. A more detailed analysis of the number of economic regimes distribution reveals some variability across economies. In particular, Morocco stands out for its marked transition in GDP growth rate, as illustrated by the identification of 17 different regimes. Egypt, for its part, is characterised by a generally positive growth rate over the period studied. Algeria, Egypt and Tunisia show similarities in their regime fluctuations, both in terms of the number of regimes observed and the amplitude of these fluctuations. Syria and Iraq also show similarities in most of their economic regimes, although Iraq's real GDP growth rate seems to show greater severity and instability. Finally, the other economies examined appear to have more balanced regimes, suggesting potentially less volatile economic dynamics. These observations underline the ability of the MS-VAR model to identify and distinguish different regime dynamics within the economies analysed.

Table 2.
The Markov switching dynamic model estimation for the regime 0 and regime 1.

Variable	regime	ALG	BAH	UAE	EGY	IRAN	IRAQ	JOR	MOR	OMA	SA	SYR	TUN
Const	*Regime 0*	-3.724 (0.000)	-2.993 (0.001)	-2.164 (0.021)	1.2324 (0.000)	0.19054 (0.853)	-24.096 (0.000)	-5.192 (0.000)	-4.290 (0.000)	-4.8576 (0.000)	-0.4132 (0.395)	-11.819 (0.000)	-0.3384 (0.156)
	Regime 1	1.704 (0.000)	4.383 (0.000)	3.7029 (0.000)	2.9792 (0.000)	2.3508 (0.090)	2.510 (0.343)	3.7575 (0.000)	8.0809 (0.000)	-0.5353 (0.184)	5.1862 (0.000)	3.8486 (0.000)	2.2273 (0.000)
ALG	*Regime 0*		0.2558 (0.095)	1.9702 (0.000)	0.1543 (0.029)	1.10612 (0.000)	1.804 (0.028)	0.2747 (0.230)	0.7095 (0.001)	-0.2015 (0.360)	0.6713 (0.001)	-2.4416 (0.000)	0.5964 (0.000)
	Regime 1		-0.8475 (0.000)	-0.2932 (0.098)	0.2101 (0.033)	-0.6429 (0.077)	-0.3232 (0.749)	0.6647 (0.000)	0.5472 (0.007)	-0.315 (0.005)	0.9166 (0.000)	0.3112 (0.104)	0.1425 (0.068)
BAH	*Regime 0*	0.1469 (0.049)		-0.0252 (0.798)	-0.1312 (0.002)	0.09493 (0.525)	-0.907 (0.298)	0.4582 (0.000)	-0.107 (0.344)	-1.045 (0.000)	-0.004 (0.950)	-1.496 (0.000)	0.1918 (0.000)
	Regime 1	-0.0377 (0.596)		0.3472 (0.005)	0.18206 (0.015)	-0.0638 (0.968)	0.6292 (0.093)	0.4582 (0.000)	-1.041 (0.000)	0.0448 (0.456)	1.7379 (0.000)	-0.1241 (0.267)	0.3389 (0.000)
UAE	*Regime 0*	0.1259 (0.051)	0.06323 (0.132)		-0.0392 (0.031)	0.1327 (0.255)	0.08919 (0.792)	-0.4488 (0.000)	-0.4762 (0.000)	-0.2155 (0.000)	1.108 (0.000)	0.3461 (0.001)	-0.0205 (0.435)
	Regime 1	0.1357 (0.001)	0.03393 (0.560)		-0.0794 (0.002)	0.50968 (0.001)	-0.2833 (0.330)	-0.1784 (0.003)	-0.0348 (0.492)	-0.0125 (0.738)	0.01615 (0.707)	-0.3004 (0.002)	0.107 (0.024)
EGY	*Regime 0*	0.5979 (0.004)	0.7011 (0.036)	-1.0436 (0.008)		-1.346 (0.005)	6.805 (0.000)	0.0638 (0.875)	1.2512 (0.005)	1.01119 (0.000)	-1.397 (0.000)	3.588 (0.000)	-0.5942 (0.000)
	Regime 1	-0.0030 (0.988)	-0.6037 (0.004)	-0.5033 (0.040)		1.260 (0.011)	4.9341 (0.000)	-1.0268 (0.000)	-0.9654 (0.001)	0.7957 (0.000)	-1.234 (0.000)	-0.760 (0.030)	-0.0233 (00818)
IRAN	*Regime 0*	0.1482 (0.007)	0.04589 (0.418)	-0.0518 (0.676)	-0.0407 (0.215)		-0.9688 (0.066)	-0.2847 (0.015)	-0.1126 (0.160)	-0.2519 (0.000)	-0.3621 (0.000)	1.538 (0.000)	-0.0031 (0.924)
	Regime 1	0.0725 (0.178)	0.02803 (0.601)	0.0091 (0.884)	0.06544 (0.073)		-0.2384 (0.414)	-0.1692 (0.005)	-0.1497 (0.027)	-0.0067 (0.879)	-0.0688 (0.477)	-0.7939 (0.000)	0.4156 (0.000)
IRAQ	*Regime 0*	-0.0167 (0.242)	-0.0099 (0.531)	0.09287 (0.002)	0.0288 (0.000)	0.00966 (0.804)		-0.0484 (0.135)	-0.0159 (0.484)	-0.0593 (0.018)	0.1788 (0.000)	-0.2346 (0.000)	0.0711 (0.000)
	Regime 1	-0.0325 (0.012)	0.07376 (0.002)	0.1279 (0.000)	0.04866 (0.000)	-0.1331 (0.023)		0.03333 (0.027)	-0.0017 (0.928)	-0.0547 (0.000)	0.0636 (0.011)	0.04926 (0.106)	0.04021 (0.002)
JOR	*Regime 0*	0.3013 (0.023)	0.0805 (0.137)	-1.569 (0.000)	-0.0558 (0.035)	-0.016 (0.901)	-1.580 (0.023)		-0.5074 (0.000)	-0.0813 (0.297)	0.3768 (0.000)	1.2804 (0.000)	0.1732 (0.000)
	Regime 1	0.1720 (0.005)	-0.6161 (0.000)	-0.4047 (0.000)	-0.0377 (0.423)	-0.1212 (0.495)	0.417 (0.235)		-0.9512 (0.000)	-0.1051 (0.073)	0.4834 (0.000)	0.5948 (0.000)	0.07615 (0.124)
MOR	*Regime 0*	0.1185 (0.096)	-0.0439 (0.565)	-2.0096 (0.000)	0.01438 (0.677)	0.05032 (0.694)	0.1343 (0.788)	-0.4622 (0.000)		0.1999 (0.036)	0.36806 (0.000)	1.3419 (0.000)	0.0720 (0.050)
	Regime 1	0.0139 (0.834)	-0.1979 (0.005)	-0.1412 (0.050)	0.14807 (0.000)	0.2937 (0.226)	-1.097 (0.055)	-0.315 (0.000)		-0.1996 (0.001)	0.8242 (0.000)	0.2251 (0.024)	0.01739 (0.723)
OMAN	*Regime 0*	0.1012 (0.290)	-0.775 (0.000)	0.4154 (0.014)	0.2271 (0.000)	-0.2645 (0.132)	-1.296 (0.032)	0.753 (0.002)	-0.2898 (0.031)		0.1071 (0.113)	-0.7887 (0.000)	0.6325 (0.000)

	Regime 1	-0.1258 (0.298)	0.2269 (0.008)	0.5101 (0.001)	0.2159 (0.000)	-0.6805 (0.009)	-5.456 (0.000)	0.2726 (0.002)	0.5420 (0.000)		0.1798 (0.210)	0.4431 (0.001)	0.2105 (0.000)
SA	*Regime 0*	-0.0737 (0.153)	-0.1352 (0.033)	1.1416 (0.000)	0.05155 (0.042)	-0.1889 (0.111)	-2.1817 (0.000)	0.8032 (0.000)	0.3662 (0.002)	0.2284 (0.000)		-0.3748 (0.001)	0.1049 (0.002)
	Regime 1	-0.0932 (0.127)	0.2441 (0.000)	0.4299 (0.000)	-0.015 (0.472)	-0.627 (0.001)	-0.8844 (0.012)	0.00392 (0.930)	0.2353 (0.000)	-0.2335 (0.000)		-0.0257 (0.718)	-0.2814 (0.000)
SYR	*Regime 0*	-0.2065 (0.000)	-0.1624 (0.000)	0.6524 (0.000)	0.04899 (0.002)	0.2649 (0.000)	1.3113 (0.033)	0.3359 (0.000)	-0.0761 (0.140)	-0.1667 (0.000)	0.1331 (0.002)		-0.0361 (0.042)
	Regime 1	-0.070 (0.058)	-0.1927 (0.007)	0.07089 (0.085)	-0.1472 (0.000)	0.264 (0.041)	0.5266 (0.006)	0.1862 (0.000)	0.246 (0.000)	-0.1914 (0.002)	-0.4172 (0.000)		0.01103 (0.672)
TUN	*Regime 0*	0.2375 (0.025)	0.2697 (0.030)	-0.0031 (0.988)	-0.0376 (0.556)	0.4602 (0.137)	0.2365 (0.784)	1.0392 (0.003)	0.5699 (0.001)	0.4203 (0.003)	-0.1645 (0.174)	-0.3427 (0.322)	
	Regime 1	0.3641 (0.002)	0.40602 (0.001)	-0.620 (0.001)	-0.2223 (0.001)	0.6828 (0.071)	5.2031 (0.000)	0.3946 (0.001)	0.1325 (0.296)	1.01169 (0.000)	-1.287 (0.000)	-0.3503 (0.020)	
Sigma		0.754 (0.000)	0.9134 (0.000)	1.0967 (0.000)	0.3865 (0.000)	1.986 (0.000)	5.209 (0.000)	0.982 (0.000)	1.048 (0.000)	0.7559 (0.000)	0.9921 (0.000)	1.369 (0.000)	0.4797 (0.000)
Linearity LR-test Chi^2(14)		29.30 (0.009)	49.882 (0.000)	78.531 (0.000)	50.618 (0.000)	34.999 (0.001)	41.188 (0.000)	65.572 (0.000)	56.866 (0.000)	74.371 (0.000)	87.433 (0.000)	77.720 (0.000)	73.208 (0.000)
log-likelihood		-70.35	-79.231	-88.224	-44.42	-106.6	-153.4	-80.43	-82.02	-70.69	-85.50	-98.61	-54.91

Note:(…): P-value.

The results presented in Table 2 demonstrate the suitability of the Markov switching model for analysing time series data from MENA countries, as evidenced by the combined outcomes of the linearity LR test and log-likelihood values. The Linearity LR test consistently rejects the linearity hypothesis across all countries, with significant p-values indicating that a simple linear model is inadequate and that switching between economic regimes is necessary. Log-likelihood values exhibit variation among countries, with Egypt showing the best model fit at -44.42, while Iraq has the poorest fit at -153.4, reflecting significant challenges in capturing its economic dynamics. Tunisia (-54.91) and Iran (-106.6) fall in between, illustrating differing levels of model accuracy. These findings underscore the relevance of the Markov switching model and highlight distinct variations in the model's applicability based on each country's economic characteristics.

From the results of the MSD models, the sigma parameters reveal significant differences in the ability of the model to adjust to data from different economies in the MENA region. Iraq stands out with the highest volatility (5.209), suggesting that the MSD model has more difficulty in reproducing its economic dynamics. Conversely, Egypt has the lowest volatility (0.386), indicating a better fit. The other economies, such as Morocco, Bahrain, The United Arab Emirates, Jordan, Saudi-Arabia and Syria show moderate volatility with a sigma value between 0.75 and 1.37, indicating an intermediate level of uncertainty in the MSD model's ability to predict their economic fluctuations. Iran, with a value of 1.986, shows relatively high volatility, implying a less perfect fit compared to other economies in the region.

The estimated coefficients:

The results of the $MSD(2)$ model reveal a significant difference between the two observed regimes. Nearly all the economies analysed exhibit a negative constant in regime 0, which points to a crisis or stagnation period, while regime 1 is defined by positive constant, indicating an expansion or growth period. From the value of the constant in the two regimes, which reflects different dynamics depending on the prevailing regime, I can note some important comments. Firstly, Iraq characterized by a largest amplitude (from -24.096 to 2.51) highlights a disastrous regime 0 and an exceedingly unstable economy. Moreover, the return to growth is not totally assumed (p-value=0.343). Similarly, Syria showed a same situation with high volatility between regimes. Morocco, meanwhile, shows a spectacular transition from deep crisis to strong expansion (from -4.29 to 8.08). In contracts some economies display weak or insignificant trends. Iran shows unclear effects that could indicate a more gradual transition. Oman, with a negative constant in both states (from -4.85 to -0.53), indicating persistent difficulties. Finally, Tunisia has a constant of -0.34 in regime 0, which is not significant, while regime 1, shows a clear improvement with a clear improvement with a constant of 2.23. Therefore, the intensity of the crisis and the recovery rhythm vary from economy to another. Iraq, Syria and Morocco are considered as a country with high levels of instabilities. In contrast, countries such as Bahrain, the United Arab Emirates, Jordan and Saudi Arabia are experiencing a strong recovery in regime 1. Meanwhile, Iran, Oman and Tunisia are experiencing a smoother transition.

The interdependence coefficients presented in Table 2 and their significance level of business cycles fluctuations show that MENA economies have complex and varied economic relations. On the one hand, some countries have strong positive relationships, meaning that their economic growth is linked and that they mutually benefit from each other's development. For example, growth in Bahrain is associated with growth in Algeria, and growth in United Arab Emirates stimulates growth in Egypt. Similarly, the business cycle fluctuations of Algeria stimulate that of United Arab Emirates with a coefficient of 0.1357, reflecting a pro-cyclical relationship. On the other hand, the results also show a significant negative interdependence of business cycle fluctuations in some economies on others. For instance, the relatively small impact of Iraq and Syria on the Algeria business cycle, with corresponding coefficients of -0.0325 and -0.07 in regime 1, respectively. The business cycle dynamics of Bahrain, United Arab Emirates and Syria reveal complex relationships in different regimes. In recession (regime 0), Bahrain benefits from positive contributions from Algeria, Egypt and Tunisia business cycle dynamics, while the United Arab Emirates is supported by Algeria, Oman, Saudi-Arabia and Syria. In contrast, in expansion (regime 1), Bahrain business cycle is negatively affected by Algeria, Egypt, Morocco and Syria ones, while United Arab Emirates real GDP is negatively affected by Algeria, Egypt, Jordany, Morocco and Tunisia ones. Similar, Syria benefits positively from United Arab Emirates, Egypt and Iran in recession regime, but negatively affected by the same countries – United Arab Emirates, Egypt, Iran, Jordany and Tunisia- in expansion regime.

The results also show that Saudi Arabia and Egypt appear to be the main economic actors in the MSD model, playing key roles in the growth of several economies. The Saudi Arabia macroeconomic fluctuations affect North Africa (Morocco and Tunisia), the Gulf, and the Middle East (Syria and Iran). This influence is in line with Saudi Arabia's considerable economic clout, financial resources, and strategic importance in the MENA region. Meanwhile, Egypt plays a crucial role by positively impacting the economic ties among Maghreb countries while simultaneously opposing Iran economically, highlighting underlying strategic differences in trade and investment. Egypt's strategic geographic location and substantial population bolster its capacity to shape regional economic dynamics, solidifying its status as a pivotal economic force in the MENA region.

The results also reveal a significant interdependence of real GDP growth rates, both between Algeria and Tunisia and between Saudi Arabia, Iraq, Jordan, and Syria. This dynamic can be explained by several economic theories. For example, the theory of localization emphasizes that the concentration of economic activities in geographical proximity facilitates interactions and exchanges, thereby strengthening interdependence. Furthermore, gravity models confirm this observation by stating that the closer two countries are, the more significant their trade exchanges are, which inevitably influences the synchronization of their economic performances.

It appears that the dynamic study of fluctuating real GDP growth rates in the MENA region confirms the static results. Thus, fluctuations in GDP growth rates in most of the region's economies have a significant effect on each other. The interdependence among the countries in the MENA region is the result of several key factors. Firstly, the trade relations between these countries mean that variations in GDP growth rates in one economy can influence the demand for imports and exports from neighbouring countries. Studies by the World Bank and the OECD indicate that these economic interactions can lead to significant spillover effects. Additionally, economic ties established through trade agreements, investments, and financial collaborations create mutual dependencies. Furthermore, the sharing of natural resources, such as oil and gas, means that price fluctuations can have a significant impact regionally. Political and social factors also play a role, as the stability of one country can affect its neighbours, leading to economic repercussions. Finally, global economic fluctuations exert an additional influence, affecting the interconnected economies of the region.

4. Conclusion

This study provides an analysis of macroeconomic dynamics within the 12 countries of MENA region (Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Morocco, Oman, Saudi Arabia, Syrian, Tunisia and United Arab Emirates) spanning the period from 1980 to 2022. A static and dynamic approaches have been established in order to understand the dynamic and interdependence of the macroeconomic growth rate in our sample. The static analysis reveals that Morocco's real GDP growth rate experiences significant volatility, indicating frequent fluctuations in macroeconomic performance. In contrast, Egypt maintains a generally positive growth trajectory, suggesting a more stable economic environment. On the other hand, Iraq's real GDP growth rate is marked by pronounced severity and instability, reflecting deeper economic challenges and uncertainties. Within the Arab Maghreb region, there is a notable similarity, as many countries (Tunisia, Algeria) share comparable regimes and characteristics. This indicates that political and economic dynamics are often influenced by similar historical and cultural contexts. Moreover, significant similarities are also observed among various states, particularly between Iraq and Syria, where both countries face analogous challenges in terms of governance and economic development.

The dynamic approach, based on the Markov-switching vector autoregressive (MS-VAR) model, allows research to effectively capture the complex regime shifts that characterise the region's diverse economic landscape, thus promoting a more accurate understanding of how economies function and interact over time. The MS-VAR methodology is proving to be a valuable tool for exploring the dynamic economic interactions that exist among MENA countries within different economic regimes. This is particularly important given the region's exposure to a range of internal and external factors, including commodity price volatility, geopolitical instability and varying degrees of global economic integration.

A core finding of this research is the demonstrable degree of interconnectedness among MENA economies. The study highlights that the economic fortunes of these nations are, in many cases, intertwined, and that regional events and policies can have significant ripple effects. Two countries emerge as pivotal economic drivers within this network: Saudi Arabia and Egypt. The analysis reveals that Saudi Arabia exerts a broad influence across North Africa, the Gulf states, and the broader Middle East. This influence is likely driven by a combination of factors, including the country's vast oil reserves, its significant financial resources, and its prominent role in regional geopolitical affairs. Egypt, in contrast, is identified as a key shaper of economic relationships within the Maghreb region, with the model illustrating the strategic economic connections between this country and its North African neighbours. Egypt's influence likely stems from its significant population, strategic geographic location, and established economic ties within the region.

Thus, at the end of this study, it is crucial to emphasise that for the MENA region to fully realise its economic potential, a more cooperative approach is needed - one that highlights the strengths of each country while addressing common challenges. This includes the establishment of harmonised and coordinated economic policies aimed at strengthening regional integration.

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