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Growth, Fluctuations and Macroeconomic Policies: Evidence from Arab open economies

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Abstract. In this paper, we examine empirically the Macroeconomic policy impact on economic Growth in four Arab open economies over the period 1982-2013. The multivariate Markov switching approach is used to study the trade openness, financial development, financial integration, inflation and investment shock effects on growth according to the economic state. Our findings are (*i*) two economies were under persistent recession states for most of the time, (*ii*) macroeconomic policy do not lead to dynamic gains from trade in the largest Arab countries, (*iii*) inflationary pressure stimulates economic growth through domestic investment, (*iv*) financial Integration and the financial Development suggest that structural reforms in the banking sector and financial markets should be implemented, and (*v*) short term stabilization policies should be accommodated to the macroeconomic fluctuations.

Keywords: MSM-VAR models, Economic growth rate, Trade openness, financial integration.

1. Introduction

During the last two decades, there has been a growing body of applied literature documenting the determinants of economic growth in some particular contexts. Accordingly, capital accumulation is presented as an important factor in the rapid growth of East Asian economies (Krugman [1994] and Young [1994]), while Huang and Drysdale (1997) show that productivity growth was a major contributor to the growth in these countries. In addition, some other works have emphasized the effects of policy on growth, since the new growth theory has argued the non-neutrality of economic policy in the growth process (Romer [1990]). Indeed, public expenditure, human capital investment, and the improvement of the labor quality may accelerate growth rate by their effect on productivity (Barro [1996], Robertson [2000]). Furthermore, trade policy seems to have an interesting effect on the growth path by its effect on the price system and on the resource allocation (Michaelly *et al*. [1991], Page [1994], Kwabena [2004]).

However, given some unexpected shocks from the variability of economic policies, from the relative prices, and from demand and supply behavior, the growth rate may be unstable (Chebbi (2015)). In the empirical literature, a few models enhancing the understanding of the important factors and vehicles of economic growth have been elaborated. Hartwig (2010) and Kar *et al.* (2011) have used a Granger Causality. Risso *et al.* (2013) and Sahoo *et al.* (2014) have used a co-integration approach. Barro (1996) and Kwabena (2004) have focused on linear regressions. However, the nonlinear models dealing with the switching regime models are more appropriate to the fluctuation investigations since they are based on the RBC approach. For this purpose, the Markov Switching Autoregressive Vector (MS-VAR) model of Krolzig (1997) widely adopted in the empirical studies is an extension of Hamilton's work.

Although the application of this model allows the studying of the determinants of growth for different states and seems to be important in terms of political stabilization, only few works, such as Anna and Anke (2010) who identified the transmission mechanisms in Armenia and, more recently, Beatrice *et al.* (2013) who have applied this approach in South Africa, are available in the applied literature.

In this paper, we use the motivated switching regimes approach to study the determinants of the economic growth in some Arab countries, namely, Algeria, Morocco, Saudi Arabia and Tunisia. Indeed, these economies are currently in a macroeconomic instability affecting their growth path in different ways. For this purpose, we study the asymmetric effects of the various shocks on economic growth rate conditional on the state of the economy.

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This paper is organized as follows. Section 2 describes the *MS-VAR* model and the estimation process via the Expectation Maximization (*EM*) algorithm. Section 3 provides datasets and the preliminary treatment. Section 4 presents the empirical results and interpretations. Finally, we conclude in section 5.

2. The MS-VAR Model

Following the seminal paper of Sims (1980), the autoregressive vector model has been widely used in empirical macroeconomics to study the main effects of macroeconomic shocks and the responses of the economy to them. In this model, the evolution of the economy can be described by the dynamic behavior of a set of lagged variables. The main idea through the multivariate Markov Switching (*MSM-VAR*) model is that the parameters of $p-\dim ensional$ vector time series depend upon an M unobservable regimes.

Let y_i denote a $MSM(M)-VAR(p)$ process. The corresponding equation may be written as follows,

$$\phi(B)(y_t-\mu(s_t))=\varepsilon_t \qquad (1)$$

Where $\varepsilon_t \sim \text{NID}(0,\sigma?$, and the conditional mean $\mu(s_t)$ switches between M *states* .

To avoid the disadvantages of the conventional procedure of estimating the parameters of the model, we adopt the two-step Expectation Maximization (*EM*) algorithm due to Dempster *et al.* (1977). In the first expectation's step, population parameters, including the joint probability density of unobserved states, are estimated. In the second optimization step, probabilistic inferences about the unobserved states are made by using a nonlinear filter and smoother. Filtered probabilities $P(s_t=j|\psi_t)$ are obtained by inferences about s_t conditional on information up to time t and smoothed probabilities $P(s_t=j|\psi_T)$ are obtained by inferences about s_t by using all the information available in the sample for $t=1,2,\ldots T$. This two-step procedure is repeated until it reaches the convergence.

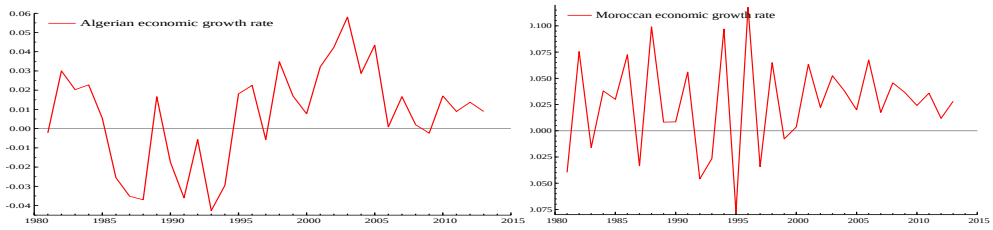
3. Dataset and Preliminary Treatment

3.1 The dataset

The real *GDP* per capita (*RGDP*) is always the most appropriate indicator of economic growth (Barro [1995], Makiw [1992], Edison *et al.* [2002] etc.). We are going to consider the variable to study economic activities of Algeria, Morocco, Saudi Arabia and Tunisia shown as follows:

$$GROWTH_t=\frac{RGDP_t-RGDP_{t-1}}{RGDP_{t-1}} \qquad (2)$$

We notice that the accumulation, the economic policy, and the macroeconomic environment are considered as the most important determinants of economic growth. Let's consider the following variables: The gross fixed capital formation (GFCF), the Inflation Rate (*INF*), the financial development (*FDEV*), the trade openness (TRADE) and the financial integration (*FI*). As a measure of the degree of financial integration, we use the updated version of the dataset on foreign assets and liabilities constructed by Lane and Milesi-Ferretti (2007)[1]. We prefer these data which are based on *de facto* measures on *de jure* measures as the latter do not reflect the degree of enforcement of capital controls and therefore the actual degree of financial integration in the world financial markets. So, the degree of international financial integration is approximated by the sum of the total assets and liabilities as a share of *GDP*.



[1]We are grateful to Philip R. Lane and Gian Maria Milesi-Ferretti for providing us with the database on capital stocks.

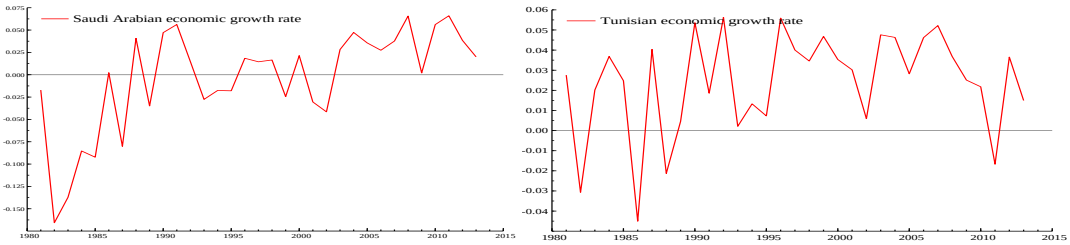


Fig. 1: Annual economic growth rates.

The graphical analysis of the annual growth rate of the real *GDP* per capita shows that all countries have experienced fluctuating economic growth between 1980 and 2013[2]. As for Algeria, the simple average economic growth rate is about 0,69% with a standard deviation (2,51%). The growth rate reached its highest point in 2003 (5,8%), while its lost point was for –4,26% in 1993. Morocco's economy has registered an average economic growth rate of 2,6% during this period with a volatility of 4,5%. A negative growth rate of 7,7% was recorded in 1995 while he highest growth rate was in the range of 11,76% in 1996. Saudi Arabia experienced high economic growth volatility with the highest standard deviation of 5,7%. The lowest and highest growth rates recorded by this country are at about -16,57% in 1982 and 6,6% in 2011 respectively. Finally, the Tunisian average economic growth rate is about 2,4% with variability over the period of about 2,51%. The minimum was about –4,5% reached in 1986 while the highest rate was reached in 1992 (5,6%).

3.2 Preliminary tests

To specify the MS-VAR model, we check the stationary of each variable using the ADF, KPSS and PP tests. The results show that all-time series are first order integrated. All variables follow the MSM(2)-VAR(1) models. Let's use the following equation to test Granger causality:

$$GROWTH_t = \alpha_0 + \sum_{i=1}^{p_1}\beta_i GROWTH_{t-i} + \sum_{j=1}^{p_2}\gamma_j TRAD_{t-j} + \sum_{k=1}^{p_3}\varphi_k FDEV_{t-k} + \sum_{l=1}^{p_4}\pi_l FI_{t-l} + \sum_{m=1}^{p_5}\omega_m INF_{t-m} + \sum_{n=1}^{p_6}\lambda_n \mathrm{GFCF}_{t-n} + \varepsilon_t \qquad (3)$$

Based on the Fisher test, the results of the granger causality test are given in following table:

Tab. 1: Pairwise Granger Causality Tests.

Null hypothesis : X does not Granger Cause Y	Algeria		Morocco		Saudi Arabia		Tunisia	
	F-statistic	Probability	F-statistic	Probability	F-statistic	Probability	F-statistic	Probability
Growth → TRADE	1.8339	0.1760	1.7783	0.1820	0.0943	0.7590	2.0795	0.1490
TRADE → Growth	0.2475	0.6190	0.8633	0.3530	2.2553	0.1330	0.2221	0.6370
Growth → FDEV	5.7459	0.017*	0.0135	0.9080	0.4056	0.5240	0.0009	0.9760
FDEV→ Growth	0.7742	0.3790	0.2190	0.6400	0.1385	0.7100	0.1980	0.6560
Growth → FI	3.8083	0.0510	0.1524	0.6960	0.1379	0.7100	1.3840	0.2390
FI → Growth	13.6670	0.001*	0.1027	0.7490	0.0145	0.9040	3.5857	0.0580
Growth → INF	0.1476	0.7010	0.4229	0.5160	0.1772	0.6740	0.8223	0.3650
INF → Growth	4.3221	0.038*	0.0009	0.9760	0.1012	0.7500	0.5088	0.4760
Growth → GFCF	0.1345	0.7140	0.0265	0.8710	0.0427	0.8360	0.0580	0.8100
GFCF → Growth	0.4803	0.4880	11.6080	0.001*	2.2611	0.1330	0.0042	0.9490
** Denotes the rejection of the null hypothesis at 5% significance level*								

At the 5% significance level, we accept, for Algeria, the null hypothesis that Growth does not Granger cause TRADE, GFCF and INF. However, results revealed that Growth Granger cause FDEV and FI.

The pairwise Granger causality tests suggest that, for Morocco, we cannot reject the null hypothesis of the causality between Growth and the other variables. Similarly, there is no Granger causality between TRADE, FDEV, FI and INF and Growth while GFCF is Granger cause Growth.

For Saudi Arabia and Tunisia, the results suggest that there is no Granger causality between variables.

To evaluate the quality of MSM-VAR model against a time invariant linear model, the likelihood ratio (*LR*) test is applied, which is asymptotically $\chi^2_{(r)}$ distributed. The *LR* statistics for Algeria, Morocco, Saudi Arabia and Tunisia are respectively 31.81; 28.62; 36.39 and 41.75 while the $\chi^2_{(8)} = 15.5073$. These results show that the *MS-VAR* model is more appropriate than the *VAR* one. Therefore, we characterize the economic growth of each country by two states. The first regime ($s_t = 1$) represents the recession state while the second one ($s_t = 2$) represents the expansion state.

[2]Author's calculation.

4. Empirical Finding and Interpretations

Table 2 shows the estimation results of the various *MSM-VAR* models with different business cycle characteristics of each country. As shown in the table, all studied economies are characterized by two states, i.e. expansion and recession regimes.

Following Sims (1980), the parameters estimates are not interpretable in the structural form of the model. They are useful only for the control of the cyclical behavior over time. For this reason, we transformed the initial estimated model to its reduced version to obtain the long term effects of the explanatory variables in the growth equation (3). Then, we consider the simple long term conditions i.e. $y(t) = y(t-i)$, and $x(t) = x(t-j)$ for all $t \in [1983,\ 2013]$, and i, j the lag numbers; where y is the endogenous variables vector, and x is the exogenous variables vector.

$$\begin{cases} \alpha^* = \dfrac{\alpha}{1-\beta_1-...-\beta_{p_2}}; \gamma^* = \dfrac{\gamma_1+....+\gamma_{p_2}}{1-\beta_1-...-\beta_{p_1}}; \varphi^* = \dfrac{\varphi_1+....+\varphi_{p_3}}{1-\beta_1-...-\beta_{p_1}}; \\ \pi^* = \dfrac{\pi_1+....+\pi_{p_4}}{1-\beta_1-...-\beta_{p_1}}; \omega^* = \dfrac{\omega_1+....+\omega_{p_5}}{1-\beta_1-...-\beta_{p_1}}; \lambda^* = \dfrac{\lambda_1+....+\lambda_{p_6}}{1-\beta_1-...-\beta_{p_1}} \end{cases} \quad (4)$$

The long-term coefficients estimates are provided in following table.

Tab. 2: Multivariate Markov-switching model estimates under scenario.

	Algeria	Morocco	Saudi Arabia	Tunisia
Mean (Reg.1)	-0.00026 (-0.02)	0.018620 (3.2485)	-0.011033 (-0.6004)	0.018585 (2.2833)
Mean (Reg.2)	0.0146 (1.631)	0.033154 (4.8858)	0.059645 (2.6423)	0.031004 (3.0861)
GROWTH_1	0.5894 (3.905)	-0.628783 (-4.1309)	0.701331 (5.2190)	-0.161892 (-0.776)
TRADE_1	0.00097 (1.311)	0.001402 (1.1428)	-0.000145 (-0.1056)	-0.001515 (-2.246)
FDEV_1	0.00101 (2.186)	0.000062 (0.1181)	0.000156 (0.7438)	-0.000492 (-0.620)
FI_1	0.001008 (2.58)	0.000050 (0.0738)	0.000418 (1.0129)	-0.000891 (-1.852)
INF_1	-0.00007 (-0.11)	-0.001011 (-0.4031)	0.005701 (1.5920)	-0.002416 (-0.858)
GFCF_1	-0.00054 (-0.33)	-0.002195 (-0.4740)	-0.003126 (-0.7255)	0.001329 (0.4542)
SE	0.017495	0.029724	0.03558	0.023560
AIC	27.3516	26.962	31.5745	25.0216
LR	31.8061	28.6223	36.3928	41.7562
Loglikelihood	-366.6256	-360.3916	-434.1918	-316.8342
(…): T-student.				
State properties				
N.OBS	14 18	14 18 24	8 16	15
Probabilities	0.4375 0.5625	0.4375 0.5625 0.7731	0.2269 0.4828	0.5172
Duration	2.8 3.6	4.67 6 7.67	2.25 2.14	2
Transition probabilities				
P_{11}	0.6429	0.7857	0.8696	0.5333
P_{22}	0.7222	0.8333	0.5556	0.5

Tab. 3: Long terms coefficients estimation results.

Coefficients	Algeria		Morocco		Saudi Arabia		Tunisia	
α^*	-0.000636	0.035618	0.011432	0.020355	-0.036941	0.199703	0.015995	0.026684
γ^*	0.002373		0.000861		-0.000485		-0.00 304	
ϕ^*	0.002480		0.000038		0.000522		-0.000423	
ω^*	0.002455		0.000031		0.001400		-0.000767	
π^*	-0.000188		-0.000621		0.019088		-0.002079	
λ^*	-0.001330		-0.001348		-0.010466		0.001144	

For the Algerian economy, the foreign trade (TRADE), the financial development (FD) and the financial integration (FI) contribute positively to economic growth as expected by the analytical framework. In both Algeria and Morocco, all explanatory variables act positively on the growth rate except the Inflation and Investment. It seems that the financial system and stabilization policy require reforms to be more efficient. The negative sign of the intercept in Saudi Arabia's model indicates the convergence of the growth path toward its stationary state as predicted by the conventional mainstream literature. The inflation explains positively the growth rate through its effect on the real capital cost and then investment. In fact, it is known that the capital stock increases when the expected inflation rises. It is also expected that the openness of this economy toward international trade stimulates economic growth through the minimization of price distortions, low trade barriers, and more trade volume. However, it seems that foreign trade has not been followed by dynamic gains (growth effect) which require structural technological change (Baldwin [1989]).

The loss of competitiveness of the undiversified Saudi economy presumably due to the default of the preconditions for the opening would be the origin of these effects. Finally, the macroeconomic policy seems not to be efficient since it is negatively correlated with growth rate. Concerning Tunisian, neither Financial Development nor Financial Integration contribute significantly and positively to the growth. In fact, the financial market is yet subjected to financial repression while the financial intermediation which is dominated by the Banks requires reforms, as announced recently by the local authorities.

4.1. Transition probabilities and regime properties

Table 2 reports the estimation results of the MSM-VAR model for each country. The Algerian economic results show the persistence of the expansion state ($p_{11}=0.624,\ p_{22}=0.722$). There is a chance of 36% to move from a recession state to an expansion one ($p_{12}=0.357$) and a chance 28% to move the other way around ($p_{21}=0.278$). The recession regime tends to last 14 years on average while the expansion one is more persistent (18 years). The average duration of the expansion state is 3,6 years. The same is for Morocco, the expansion state is more persistent ($p_{11}=0.786,\ p_{22}=0.833$). The recession regime tends to last 14 years on average while the expansion one tends to last 18 years with a probability of 0,437 and 0,562 respectively. The average duration of the first regime is about 4,67 years while the duration of the second state is about 6 years. The Transition probabilities matrix of the Saudi Arabia case show the persistence of the first state ($p_{11}=0.87, p_{22}=0.55$). With a probability of about 44%, the economy moves from an expansion state to a recession one. The average duration of the expansion regime is less important than the duration of the recession one. In the *MSM (2)-VAR (1)* estimated model for Tunisia, the probability of remaining in a recession state is $p_{11}=0.53$ and the probability of remaining at the expansion one is equal to $p_{22}=0.5$. The probability of moving from a recession state to expansion one is less than the opposite probability ($p_{12}=0.47,\ p_{21}=0.5$). Regime properties show that the first state is observed in average 16 years with a probability of 0,48 while the second regime is observed 15 years in average with a probability of 0,517. The duration of the recession state is 2,14 years against 2 years for the expansion one.

In sum, countries with the highest growth rates are more likely to persist in the recession phase. This is an RBC stylized fact.

4.2. Filtered, smoothed and predicted probabilities

Figures 2, 3, 4, and 5 show the filtered, smoothed and predicted probabilities of being in a different state for Algeria, Morocco, Saudi Arabia and Tunisia respectively.

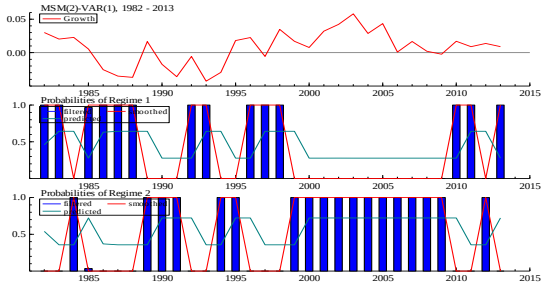


Fig. 2: The transition probabilities for Growth-Algeria.

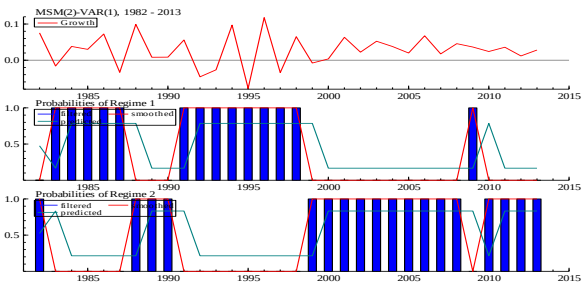


Fig. 3: The transition probabilities for Growth-Morocco.

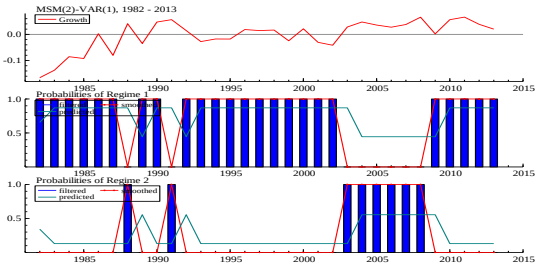


Fig.4: The transition probabilities for Growth-Saudi Arabie.

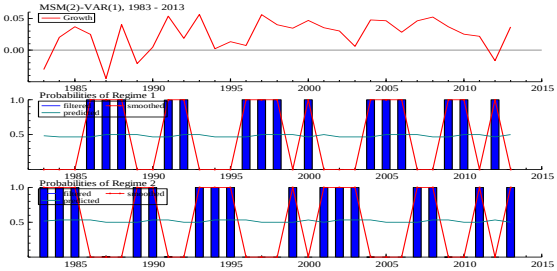


Fig. 5: The transition probabilities for Growth-Tunisia.

For Algeria the filtered probabilities show that the recessionary regime dominate for 14 years (1982, 1983, 1986-1988, 1992, 1993, 1996-1998, 2010, 2011 and 2013), while the probabilities of being in the expansion regime dominate for 18 years. From the smoothed probabilities, we draw the same results as those drawn from the filtered probabilities. From the predicted probabilities, we find some differences. In fact, for

1984, 1989, 1994, 1999 and 2012, the recessionary state dominates. For Morocco, the filtered and smoothed probabilities show that the probability of being in the first regime is observed 14 times over the years 1982-1987; 1991-1999 and 2009 while the probabilities of being in the second regime is seen 18 times over the years 1988-1990, 1999- 2002 and 2010-2013. Smoothed probabilities suggest that the probabilities of being in a recession state for the years 1988, 1999, and 2010 are greater than the probability of being in an expansion state. The graph of the filtered and smoothed probabilities for Saudi Arabia indicates that the recession regime is observed for the years 1982-1987, 1989, 1990, 1992-2002 and 2009-2013. The expansion regime holds for the years 1988, 1991-and from 2003 to 2008. After this year, the recession regime prevails. The predicted probabilities of being in a recession state is greater than 0,5 for the years 1988, 1991 and 2003.

Lastly, reviewing graphs of the filtered and smoothed probabilities for Tunisia indicate that the economy was under a recession regime for several years. Indeed, the filtered probabilities of being in state 1 are superior to 0,5 for the years 1986-1988, 1991,1992, 1994-1996, 2000, 2004-2006, 2009, 2010 and 2012. The probabilities of being in state 2 which are greater than 0,5 are observed in the years 1982-1985, 1989, 1990, 1993-1995, 1999, 2001-2003, 2007, 2008, 2011 and 2013. Finally, all the predicted states probabilities correspond to international fluctuations (recessions and expansions) observed during the sample period (1980-2013). However, the duration of each state differs from one country to another.

4.3. Impulse response functions analysis

The Cholesky decomposition adopted for forecasting error variance provides a measure of the overall relative importance of the variables in generating the fluctuations on their own and other variables. The graphical results for each country are given in the following figures 6, 7, 8 and 9.

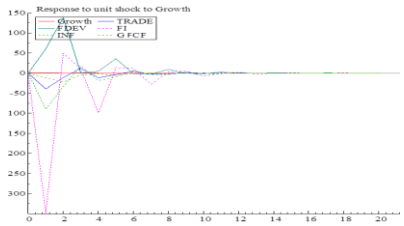


Fig. 6: The impulse response functions to unit shock to Growth-Algeria.

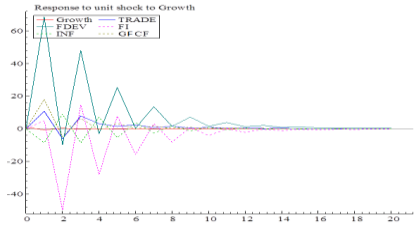


Fig.7: The impulse response functions to unit shock to Growth-Morocco.

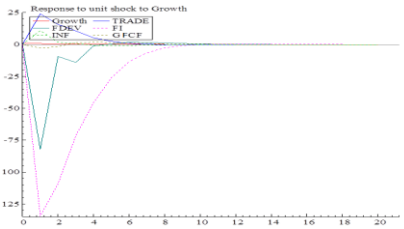


Fig. 8: The impulse response functions to unit shock to Growth-S-A.

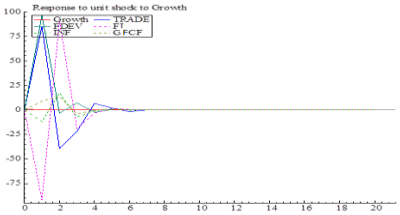


Fig. 9: The impulse response functions to unit shock to Growth-Tunisia

For Algeria, the responses of *Growth* to various unit shocks are negligible and positive. A shock of *Growth* has an increasing negative effect on *TRADE*, *FI*, *INF* and *GFCF*. A unit shock of *Growth* exerts a positive increasing effect on *FDEV*. For Morocco, the responses of *Growth* to all variables unit shocks seem to be very weak over all periods. A unit shock of *Growth* has negative effects on *INF*. *FDEV* react positively and strongly to a *Growth* unit shock. These effects remain positive but decreasing for long period. The response of *GFCF* and *TRADE* to this shock is positive but less important than those of *FDEV* and *FI*. For Saudi Arabia, the reactions of *Growth* to various unit shocks have some similarities to those of Algeria and Morocco. *TRADE* and *GFCF* react positively to a one unit *Growth* shock. The positive effect is therefore decreasing from the second year period until it becomes negligible along the rest of the period. On the other hand, unit shocks to *Growth* have important negative effects on *FDEV* and *FI* during the first year period. This effect remains negative but decreasing since the second year. Like other countries, *Growth*, *TRADE*, *FEDV*, *FI*, *INF* and *GFCF* unit shocks for Tunisia have a negligible effect on *Growth* for all the period study. A unit shock to *Growth* has an increasing negative effect on *FI* for the first year. The response becomes positive and important after the second year. However, shocks to *Growth* have strongly positive effects on

FDEV and *TRADE*. On the other hand, shocks to *Growth* have weak effects on *GFCF* and on *INF* for the first two years. Therefore, effects become negligible for the rest of the period.

5. Summary and Concluding Remarks

From the linearity test and the obtained adjustment model, we show the adequacy of the various MS-VAR models to explain the economic growth rate for the four Arab countries. Model estimation shows that the economic growth rates are characterized by asymmetry and the existence of two distinct regimes with different properties. According to the transition probabilities and average duration, Saudi Arabian and Tunisian economic growth is characterized by the persistence of recession regime which is one of the most interesting stylized RBC facts. For Algeria and Morocco, the expansion state is most persistent.

Filtered, smoothed and predicted probabilities show that expansion regime in more persistent for Algeria and Morocco. The recession regime is more persistent for Saudi Arabia and Tunisia. Impulses response functions show that the effects of various shocks on *Growth* are weak, whereas the effects of one unit shocks on other variables are more important. It seems that macroeconomic policies do not lead to dynamic gains from trade in the largest Arab countries where the inflationary pressure stimulates economic growth through domestic investment since its real opportunity cost becomes low. Financial integration and financial development suggest that structural reforms in the banking sector and financial markets should be implemented. However, the short-term stabilization policies should be accommodated to macroeconomic fluctuations. Finally, it was not possible to carry out these important results, in terms of economic policy recommendations, outside the RBC framework. In future research, it would be important to compare our parametric methodology to that of non-parametric framework where statistical inferences and bootstrapping experiments could be made.

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