

# Impact of Macroeconomic Policies on Sudanese Economic Growth: Empirical Evidence via Switching Regression

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Doi:10.19044/esj.2019.v15n7p160

URL:<http://dx.doi.org/10.19044/esj.2019.v15n7p160>

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## Abstract

This paper focuses on assessing the impact of macroeconomic policies on the expansion and contraction of Sudanese real GDP as well as the computation of the number and the expected duration of each for the period of the period 1960Q1-2017Q4. The main tools of analysis are Simple switching regression and Markov switching regression are. The unemployment growth rate is the regime-switching variable in addition to the growth rates of the nominal effective exchange rate, real money supply, current government expenditure, and development expenses as non-switching variables. Markov-switching regression also outweighs simple switching regression in terms of Akaike information criterion, and transition probabilities. Results show that monetary policy was effective between the period of 1960Q1-1976Q4 adding 1.2% of real value. This however is; contrary to the period 1977Q1-1997Q4 where 60% of real value has been lost and improved significantly in the course of 1998Q1-2017Q4, hence, missing only 1%. The effect of the unemployment rate on growth at the period of contraction is almost four-time of the expansion. The positive effect of development expenses combined with the negative impact of current expenditure on the growth rate reveals the efficacy of monetary policy over fiscal. The exchange rate operates as a shock absorber. The expected duration, and the probability of staying in contraction last more than the expansion.

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**Keywords:** Expected duration, Expansion, Contraction, Probability, Supremacy.

## 1. Introduction

Burns and Mitchell (1946) define key aspects of business cycles as comovement among separate economic indicators and partition of business

cycles into separate phases or regimes of expansions, followed by recessions, contractions, and revivals, which merge into expansion phase of the next cycle. Schumpeter (1961) isolates four stages of the business cycle: expansion which is an increase in production and prices and low-interest rates; crisis where stock exchanges crash is accompanied with multiple firms' insolvencies; recession in which prices and output plummet and interest-rates surge; and recovery which occurs as a result of the drop in prices and incomes. Business cycles according to Madhani (2010), refer to a downward and upward fluctuation of real GDP around its long-term trend. The analysis of business cycles is suitable for a range of reasons and such insights may help researchers in picking leading indicators for economic activity. However, this; will make available a set of uniformities that serve as a benchmark to scrutinize the validity of numerical versions of theoretical models (Canova 1998a, 1998b).

Frequent regime switching and; dramatic reversal in fiscal, monetary and trade policies are the main characteristics of developing countries including Sudan (Aguiar & Gopinath 2007).

International Arab Encyclopedia (5/1/2019)) emphasizes further details on the four-phase of the business cycle by Schumpeter as follows: "the movement from crisis and recession to recovery is associated with the changing structure of economic production and the behavior of economic indicators low supply that adapts to the increased demand, thus absorbing surplus in goods on the market. A decline in the factor of production prices increases investment and eventually increases output. The transition from recovery to crisis and recession goes in the opposite direction. In the stage, production is increasing up to a level that causes excess supply. Prices move downward leading to revenues, while demand for factors of production increases leading to high costs. Low effective demand also leads businesses to reduce their output entering the national economy in the new phase of recession and crisis".

Furthermore, the monetary and financial policies of the Central Bank of Sudan (CBoS) include; to keep economic growth and inflation at certain levels; to retain the exchange rate stable through annual growth of money supply and liquidity regulation via legal reserve ratios, and to open market operations as long as the private sector is provided with liquidity. The fiscal policy has two pillars: the revenues and expenditure. Revenues are composed mainly of indirect tax that constitutes an average of 55%, and a direct tax that contributes with an average of 18%. Nontax revenues are composed of fees, foreign aid and proceeds of public companies at 23%. However, the government expenditure is composed mainly of current expenditure and a large share of it goes to funding security, followed by remuneration of employees and other government activities. This part constitutes about

83.4%, while the remaining 16.6% is devoted to public investment. The link between fiscal and monetary policies passes through two factors: the budget deficit which is mainly financed by the creation of money that increases the growth of money supply, and macroeconomic framework which is used to design annual programs. The macroeconomic framework which is originally proposed by the IMF and links the following real, monetary, and external sectors. The labor sector is completely ignored despite its importance and this is one of the reasons for considering the unemployment rate as a switching variable.

To the best of my knowledge, there are few empirical studies on Sudanese business cycle and macroeconomic fluctuations in Sudan: Hamid (2017) via principal components, Abdalla (2015) using VAR and GARCH, Ahmed and Awadelbari (2014) employing OLS, and Suliman (2000) by means of an error correction model. Therefore, there arises a need to add some effort to the empirical insight on the topic. This paper is divided into three aspects; the model variables, sample size, and analytical model *i.e.* a switching regression model.

We seek to answer the following questions: does switching regression fit Sudanese data? Does data frequency matter? Does the exchange rate operate as a shock absorber? Which economic policy is more influential fiscal or monetary? Does the unemployment rate affect the growth of the economy equally in the two regimes?

The paper contains five sections besides the introduction. The literature review is in section 2, while, section 3 contains the theoretical background. The methodology and data are presented in section 4, and section 5 is devoted to empirical results and discussion. Finally, we conclude in section 6.

## **2. Literature Review**

Maneejuk, Yamaka, and Sriboonchitta, (2018) studied the US business cycle through the application of more flexible maximum likelihood via the Markov switching (MS) models. They concluded that the empirical likelihood could outweigh the classical likelihood estimators. Guérin and Leiva-Leon (2017) combined discrete forecasts of the U.S. business cycle from competing with Markov-switching models. Their finding indicated that the best combination of forecasts updates U.S. recession. The application of Markov regression by Cifter (2017) to investigate the influence of inflation on the stock market in South Africa between July 1995 and July 2017 exhibited a negative impact in the short-term, and a long-term relationship does not exist. Faulwasser, Grossy, and Semmler (2017) presented a global solution of the finite horizon monetary policy model for inflation and credit through switching regression for euro area explored by the destabilizing

effects of price and non-price drivers of the output gap. Subagyo and Sugiarto (2016) used autoregressive Markov regression to estimate the Indonesian GDP. They concluded that there is a possibility of estimation with minor modification and it involves the use of volatility feedback of equity returns to allow the switch to endogenous ones. Prukumpai (2015) examined the behavior of eight industrial portfolios belonging to Thailand stock exchange via Markov switching regression during the period of July 2005 to September 2014. The model classified betas into low beta and high beta, endorsing that the systematic risk of industrial portfolios is time-varying and regime-dependent. Milidonis (2015) used credit swap contracts by means of Merton default risk and switching regression models to indicate an increase in default probabilities, which is several months ahead of notable increases. Cheung and Erlandsson (2004) by the use of dual data frequencies, dual sample periods, and a number of specifications reject neither random walk nor Markov switching of the Deutsche mark, French franc, and the British pound. Monetary data, on the other hand, offers clear-cut evidence of the presence of Markov switching dynamics. Therefore the results emphasize the crucial role of data frequency and the sample size for defining the number of regimes.

Morgan (2011) calls for maintenance of growth through macroeconomic policy to affect aggregate demand, directly and indirectly, passing through their "microeconomic" effects on private sector conduct in Asia. His analysis has been done through descriptive statistics. Sabir and Zahid, (2010) using SAARC (Bangladesh, India, Pakistan and Sri Lanka) data from 1984 to 2009 exhibited that the usage of monetary policy to control inflation and to smooth output gap is pro-cyclical, while fiscal policy is pro-cyclical in low-income countries.

In summary of Markov-switching, regression is the more popular technique that can be applied to estimate regimes of different fields such as portfolios, credit, business cycles via various macroeconomic indicators, and exchange rates. The fiscal and monetary policy has effects on business cycles that have been estimated through descriptive and GMM. This paper further goes online with those employing switching regression to estimate business cycles and the effects of monetary and fiscal policy. The main departure from the above studies is the special emphasis on the unemployment rate as the switching variable. However, this paper agrees with Milidonis (2015) in emphasizing the role of data frequency. This paper discovers many challenges that the Sudan economy has to face of which weather conditions, modernization of the traditional sector and its integration with the modern sector, and transfer of technology, should be considered to put an end to arm and social conflicts. Also, there is a need for efficient utilization of available resources and formulation of macroeconomic policies.

### 3. Theoretical Background

Nominal Effective Exchange Rate is a weighted average (trade-weighted) of bilateral nominal exchange rates of national currency against foreign currencies. It is a weighted average of national currency exchanges for a basket of currencies. It only describes whether a currency is weak or strong,, when compared to foreign currencies. (Investopedia /6/1/2019). An increase in the index indicates an appreciation of the home currency against the basket of currencies of trading partners (World Bank REER\_database\_ver28Jun2018). The changes that occur in NEER affect other economic indicators including the growth rate of real GDP.

All additions to the money supply merely transfer real purchasing power from some actors to others. Further, real growth means an increase of the real value of all assets including money. An increase in real money supply from monetary expansion means an increase in real wealth and this brings real value into existence (Blog 2012).

The relation between growth rate and the unemployment rate is negative as Okun's law postulates, whereas the growth of 3% requires the reduction unemployment rate. An increase of the population size by 1% entails an increase in the growth rate by the same percentage. Similarly, the percentage increase in productivity should be matched with the same percentage in the growth rate to stabilize unemployment. It is worth noting that low or moderate economic growth will not reduce unemployment, and reductions of working will create jobs (Okun 1962).

Schumpeter (1961) considers the business cycles as intrinsic to the market economy. Business cycles are the end result of the creation and discharge of innovations and new knowledge control the development process. This leads to the replacement of old enterprises by new ones that apply new techniques of production. The capital market has to finance innovations to move from a static state of the economy that is characterized as a traditional production structure to a dynamic economy (Bazhal 2016). Transfer of technology issue requires the understanding of political, social and economic settings, the appropriate use of technology, the developer of technology, channels of transfer and acceptance by the end user (Ahmed, 2009). The rate of adoption is closely related the relative speed. An innovation is adopted by members of the social system as defined by Rogers (1995), and is determined by the following variables: characteristics – relative advantage, compatibility, complexity, trialability,; observability; type of innovation-decision – optional – collective – authority; communication channels,; nature of social system; and extent of change. Other important factors are the infrastructure, breakthrough by means of different barriers, funding, and timing of the transfer. The transfer of technology to the construction sector achieves its sustainability by taking

into consideration suitable practices in terms of choice of materials, their sources, construction methodologies as well as design philosophy so as to be able to improve performance, decrease the environmental burden of the project, minimize waste and be ecologically friendlier as has been perceived by Singh; (2007).

#### 4. Methodology and Data

The basic switching model postulates that the random variable  $y_i$  depends on unobserved discrete state variable  $s_i$  with  $m$  regimes. Different regressions are associated with different states (regimes). Given regressors  $X_i$  and  $Z_i$  the specification of the conditional mean of  $y_i$  is as follows:

$$\mu_i(m) = X_i'\beta_m + Z_i'\gamma \quad (1)$$

Where  $\beta_m$  and  $\gamma$  are  $k_X$  and  $k_Z$  vectors of coefficients. The former are indexed by regime while the latter are regime invariant. Regression errors follow a normal distribution. Thus, we have the model:

$$y_i = \mu_i(m) + \sigma(m)\epsilon_i \quad (2)$$

#### Simple Switching

In this case, the probabilities are constant values. More generally, varying probabilities  $P_m$  is a function of vectors of exogenous observables  $G_{t-1}$  and coefficients  $\partial$  parameterized using a multinomial logit specification:

$$P(s_i = m|\xi_{t-1}, \delta) \equiv \frac{\exp(G'_{t-1}\delta_m)}{\sum_{j=1}^M \exp(G'_{t-1}\delta_j)} \quad (3)$$

#### Markov Switching

Hamilton (2005) described the behavior of economic time series during economic recession as different, due to changes in economic policies. Shock to the mean of a series  $y_t$  at time  $t_0$ , and due to imperfect predictable forces, forecasting depends on two data regimes one up to  $t_0$  and the second after  $t_0$ . The description of the series encompasses both dates, and labeling the mean by an unobservable random variable as  $s_t = 1, 2$ . The probability law requires the treatment of  $s_{it}$  as a Markov chain with two states i.e.

$$\Pr(s_t = j|s_{t-1} = i, s_{t-2} = k, \dots, y_{t-1}, y_{t-2}, \dots) = \Pr(s_t = j|s_{t-1} = i) = p_{ij} \quad (4).$$

The inference about  $s_{it}$  depends on what happens to  $y_t$  and takes the form of two probabilities:

$$\xi_{jt} = \Pr(s_t = j|\Omega_t; \theta); \Omega_t = (y_t, y_{t-1}, \dots, y_0); \theta = (\sigma, \phi, c_1, c_2, p_{11}, p_{22}) \quad (5)$$

The inference is performed iteratively. The probabilities in a transition matrix are:

$$p(t) = \begin{vmatrix} p_{11}(t) & \cdots & p_{1M}(t) \\ \vdots & \cdots & \vdots \\ p_{M1}(t) & \cdots & p_{MM}(t) \end{vmatrix} \quad (6)$$

However, the Markov switching filter requires the initialization of the filtered regime probabilities in period 0:

$$P(s_0 = m | \xi_0) \quad (7)$$

All model variables are growth rates are calculated based on their ratios to GDP except real GDP growth and real money supply. The dependent variable is the real GDP growth rate (GR) explained by the nominal effective exchange rate (NEERDOT), real money supply (MSRDOT), and development expenditure (DVRDOT). Central Bank of Sudan provided the data except for unemployment rate and NEER obtained from World Bank data for the period 1960Q1-2017Q4.

## 5. Results and Discussion

### 5.1 Empirical Results

Breakpoint test (annex 2) discloses that all model variables are stationary having a break date at different years. An ambitious development plan, weather conditions, and macroeconomic policies are the main causes of breaks on the model variables. The year 1971Q4 witnessed the launch of the five-year plan where development expenditure (public investment) has a break. The extension of the five-year plan in 1976Q4 observed the break of the effective exchange rate time series. The outbreak of the second civil war in Sudan and the adverse weather conditions in 1984Q4 led to starvation and hence a break in the economic growth rate. Employment policies (dismiss employees for public interest) of the military government that fired large numbers of those who have been seen as opposition supporters (civil and military), and assigning jobs to pro-government led to the breakout of unemployment in 1991Q4. That was culminated by privatization policies. The real money supply break-date corresponds to the peak of the inflation rate 1996Q4. The current government expenditure also has a break date in the fourth quarter of 1999 which corresponds to the early shipment of oil that gives the government extra resources to finance its activities. Cointegration test indicates the long-run relationship among model variables (annex 3).

The application of the BDS test to the residuals of linear estimation tells that it is inappropriate; therefore, two nonlinear estimation methods have been applied to the annual and quarterly data. The table below displays a summary of the results of both methods.

Table (1) Simple &amp; Markov Switching Regression -Newton-Raphson / Marquardt steps

Variables	Simple Switching Regression		Markov Switching Regression	
	Regime 1	Regime 2	Regime 1	Regime 2
Constant	2.504***	10.109***	3.752***	2.501***
Unemployment Rate	-2.680***	0.781***	-0.849***	-3.213**
Non-switching Regressors				
Development Expenses	0.014***		0.004***	
NEER	-0.057***		-0.072***	
Real Money Supply	0.088***		0.121***	
Current Expenditure	0.022***		-0.081***	
LOG(SIGMA)	0.028		1.665***	-1.652***
Probability Parameter	1.532***		2.635082***	-2.16761***
Transition Matrix	P1	P2	P1	P2
P1	0.882	0.118	0.961	0.039
P2	0.882	0.118	0.115	0.885
Duration	5.6	1.2	25.6	8.7
AIC	5.657		5.066	

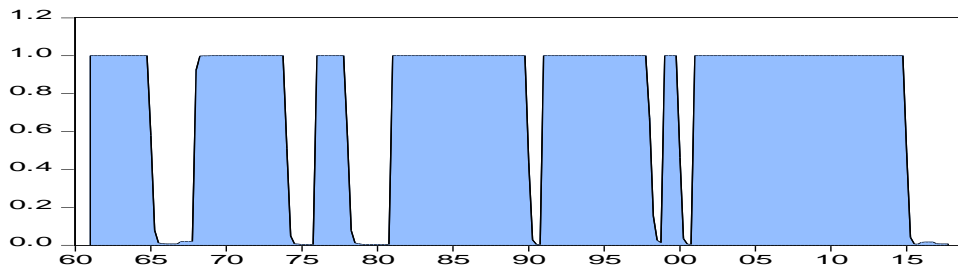
\*\*\*, \*\* and \* denote the significance at 10%, 5% and 1% level respectively. AIC indicates the Akaike Information Criterion.

The estimated constant coefficients of the simple switching regression are dissimilar in the two regimes contrary to Markov switching regression. Markov switching result is preferable to simple switching regression because of its low AIC, and correct signs of all model variables.

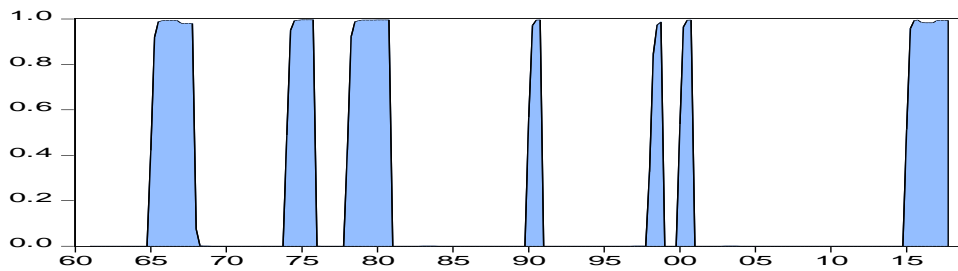
Consequently, the coefficient of the growth of unemployment rate is negative as expected. This means that an increase in unemployment in the previous quarter decreases the growth rate of the economy in the next quarter. The effect of unemployment in regime 2 is four times in regime 1. The positive coefficients of non-switching variables “real money supply and development expenses” indicate that their growth boosts the growth of the economy. In addition, the negative signs of the nominal effective exchange rate and current government expenditure do the opposite. The probability of remaining in regime 1 (expansion) is 0.961 compared to 0.885 keeping on in regime 2 (contraction). In addition, transition probability from contraction to expansion is approximately three times the transition from expansion to contraction.



Figure (1) Regime Probabilities (Expansion and Contraction)  
 Probability of Regime 1



Probability of Regime 2



The estimated duration shows that the Sudan economic expansion period lasts longer than contraction. That is, depicted by the Markov model than the simple model. The first contraction episode in the second half of the sixties corresponds to the abandonment of the ten-year development plan. However, the second displays the effect of internal political events, while the third corresponds to the end of unsuccessful five year development plan and the devaluation of the local currency for the first time in the quarter of 1978. Weather conditions mainly flood adversely affected the economic growth rate in the fourth episode and resulted to drought in fifth. The rest was due to poor economic policies, lavish expenses on non-productive activities and security, corruption, nepotism, and economic embargo by the USA. According to the Corruption Perception Index, Sudan’s score out of a clean score of 10 has been declining from 2.3 in 2003; 2.2 in 2004; 2.1 in 2005; to 1.6 in 2017 (Transparency International 2017).

**5.2 Discussion**

There is clear evidence that switching regression is suitable for estimating expansions and contractions of the Sudanese real GDP. Simple and Markov switching regression using quarterly data produced the correct signs of the main switching variable that is the unemployment rate in both regimes. The same is true for non-switching variables. However, the positive effects of development expenditure and real money supply are the expected signs as well as the negative impact of government current expenditure and NEER.

The use of annual data enforces the Markov switching regression to produce incorrect signs of the unemployment rate in regime 2, and real money supply. On the other hand, the simple switching failed to offer the correct sign of unemployment at both regimes, and real money supply. This entails the conversion of the data frequency by EViews to quarterly data, and the results confirmed Milidonis (2015) finding that data frequency matters. All results are satisfactory but should be taken with caution.

The Sudan economy is of a dual structure incorporates the traditional and modern sector. The former contains rain-fed agriculture, livestock, forestry, fishery and handcrafts, traditional mining, and traditional modes of transportation. More than 70% of the labor force is engaged in traditional sector activities using primitive technology. The weather conditions and civil war largely affect the traditional sector. The modern sector consists of manufacturing (light industries food and beverages using obsolete technology, sugar factories, and petroleum product), mining, oil industry, modern building and construction, water and electricity industries, modern modes of transportation and telecommunication. The components of the modern sectors are enclaved within the traditional sector which lack linkage. More so the construction sector suffers from insufficiency of capacity and incompetent building materials industry. This is in addition to the lack of setup, finance, production facilities, skilled labor, education, and training programs (Akra Elkhalfa et al. 2007). Furthermore, there are environmental problems of the bricks industry and contest with agriculture in terms of land usage.

The estimated coefficient of unemployment rate conforms to the finding of Ahmed and Awadelbari (2014) and Okun's law only in the expansion episode. Moreover, this conforms to Hamid (2017) in the recession episode. The main types of unemployment in Sudan are compulsory, structural, and disguised unemployment. The consecutive governments since the second half of the 1960s have been adding to compulsory unemployment by enforcing the law of "dismiss for the public interest". It also includes the privatization program and education policies that have expanded the admission of large numbers of students, in addition to corruption and nepotism, especially in the last thirty decades. The main cause of structural unemployment is the unavailability of jobs that largely matches with large of the qualification of graduates. In addition, the structure of the economy's share i.e. the agricultural sector (labor-intensive sector) was 49% during the period 1960-1976, 33% during 1977-88, and 21% in the period 1989-2017. Thus, the services sector has been increasing at the expense of the agricultural sector. The decline in agricultural share was as a result of weather conditions, civil war, and economic policies especially taxes. This; eventually triggered migration from rural to urban areas raising

the number of marginalized population and urban poor masses. Disguised unemployment is the prevailing factor owing to lack of proper job description, and the inefficient private sector.

In addition, the negative sign of the estimated NEER coefficient indicates a decrease in the weighted average which is a depreciation of the Sudanese pound against the basket of currencies. This is contrary to Suliman (2000) findings. This means an increase in competitiveness, which is in favor of economic growth. The depreciation of NEER results usually from one of three possibilities: depreciation of the national currency, decline in the trade weight, and both. The depreciation of the national currency is supposed to boost foreign trade, as it constitutes the main ingredient in the IMF and World Bank structural adjustment programs (SAPs). It is noteworthy to mention that Sudan has been implementing SAPs since 1978 without any success to realize these premises.

Real money supply was increasing in the period 1960 to 1976 with an average growth rate of 8.1% accompanied by an inflation average of 6.91% thus adding the real value of 1.19%. The average growth rates of inflation and real money supply during the period 1977 to 1997 were 57.29 and -2.04 respectively misplacing almost 60% of real value. The real money supply shows an upward trend in the period 1998-2017 with an average growth rate of 14.61 and inflation of 15.5. This is less than 1% of real value.

Furthermore, the average ratio of the amount of money devoted to public projects establishes only 16.6% of aggregate expenditure. The significant estimated coefficient of development expenses is far below the real money supply indicating the effectiveness of monetary policy compared to fiscal policy. This low effect on economic growth is due to the delays of completion of public projects as a consequence of corruption at the stages of the feasibility study, location, and execution. The estimated coefficient of development expenditure is almost the same as a current expenditure with an opposite sign. This indicates the role development expenditure can play despite its low share of total expenditure. The country is characterized as the food basket of the world owing to the abundant water and fertile land, labor-force but only 10% of the arable land is used.

## **6. Conclusion**

The efficiency of fiscal and monetary policy has been investigated by Markov switching and simple switching regression. Annual data gave some incorrect signs. We used EViews 10 for estimation and also used the facility for changing the data frequency from annual to quarter. Quarterly data produced the correct signs of all variables. The unemployment rate was the switching variable accompanied with non-switching variables. Therefore, results based on quarterly data showed that the probability of transition from

expansion to contraction is less than from contraction to expansion. Results identified eleven episodes of contractions. Real money supply also passed three phases of the addition of real value, losing of large real value, and near recovery. We recommend that public investment share of aggregate expenditure should be raised at the expense of current expenditure. The restructuring of the economy requires first the modernization of both the traditional and modern sector and finding appropriate ways to transfer technology and convince the society to adapt. Also, more efforts should be made to create jobs to reduce unemployment.

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**Annex****Annex (1) Descriptive Statistics**

	GR	NEERDOT	MSRDOT	URDOT	DVRDOT	CXRDOT
Mean	3.8	-9.2	0.1	0.4	11.3	2.17
Median	4.6	-3.4	0.1	1.0	-1.3	-1.31
Maximum	19.5	12.8	0.3	3.0	359.6	75.72
Minimum	-10.6	-92.7	-0.3	-5.0	-73.5	-41.00
Std. Dev.	5.9	19.4	0.1	1.2	68.2	22.05
Skewness	-0.1	-1.9	-0.6	-1.8	2.8	0.73
Kurtosis	3.1	7.7	3.6	9.2	13.9	4.189
Jarque-Bera	0.1	87.0	4.6	123.1	358.7	8.48
Probability	0.9	0.0	0.1	0.0	0.0	0.014
Observations	57	57	57	57	57	57

**Annex (2) Unit Root with Break Test**

Augmented Dickey-Fuller			Break Date	
	Intercept	Trend& Intercept	Intercept	Trend& Intercept
GR	-7.50***	-7.48***	1984	1984
MSRDOT	-5.78***	-6.79***	1996	1997
DVRDOT	-11.04***	-10.85***	1971	1971
URDOT	-17.61***	-17.49***	1991	1991
NEERDOT	-4.70**	-6.21***	1976	1996
CXRDOT	-10.658***	-10.801***	1999	1999
BUDRDOT	-10.69***	-10.44***	1978	1978

**Annex (3) Cointegration Test**

Date: 01/03/19 Time: 17:37					
Sample (adjusted): 1963 2017					
Included observations: 55 after adjustments					
Trend assumption: Linear deterministic trend					
Series: GR URDOT DVRDOT MSRDOT NEERDOT CXRDOT					
Lags interval (in first differences): 1 to 1					
Unrestricted Cointegration Rank Test (Trace)					
Hypothesized		Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	
None *	0.652027	134.4573	69.81889	0.0000	
At most 1 *	0.499464	76.39758	47.85613	0.0000	
At most 2 *	0.359967	38.33342	29.79707	0.0041	
At most 3	0.136775	13.79051	15.49471	0.0889	
At most 4 *	0.098465	5.701108	3.841466	0.0169	
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level					
* denotes rejection of the hypothesis at the 0.05 level					
**MacKinnon-Haug-Michelis (1999) p-values					

## Annex (4)

Dependent Variable: GR				
Method: Markov Switching Regression (Newton-Raphson / Marquardt steps)				
Date: 01/14/19 Time: 18:31				
Sample (adjusted): 1961Q1 2017Q4				
Included observations: 228 after adjustments				
Number of states: 2				
Initial probabilities obtained from the ergodic solution				
Huber-White robust standard errors & covariance				
No d.f. adjustment for standard errors & covariance				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=573892247)				
Convergence achieved after 4 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	3.751982	0.38825	9.66384	0.0000
URDOT	-0.84858	0.236513	-3.58788	0.0003
LOG(SIGMA)	1.664909	0.053697	31.00542	0.0000
Regime 2				
C	2.501912	0.046876	53.37339	0.0000
URDOT	-3.21344	0.036767	-87.3999	0.0000
LOG(SIGMA)	-1.65156	0.064212	-25.7202	0.0000
Common				
NEERDOT	-0.071510	0.00405	-17.6594	0.0000
DVRDOT	0.003522	0.000756	4.656322	0.0000
MSRDOT	0.120800	0.002783	43.40097	0.0000
CXRDOT	-0.08093	0.00161	-50.2514	0.0000
Transition Matrix Parameters				
P11-C	3.201551	0.269932	11.86057	0.0000
P21-C	-2.03898	0.4044	-5.04199	0.0000
Mean dependent variable	4.071894	S.D. dependent var		5.187634
S.E. of regression	4.838213	Sum squared resid		5103.01
Durbin-Watson stat	0.486874	Log-likelihood		-565.505
Akaike info criterion	5.065837	Schwarz criterion		5.246329
Hannan-Quinn criteria.	5.13866			

## Annex (5)

Dependent Variable: GR				
Method: Simple Switching Regression (Newton-Raphson / Marquardt steps)				
Date: 01/14/19 Time: 19:03				
Sample (adjusted): 1961Q1 2017Q4				
Included observations: 228 after adjustments				
Number of states: 2				
Huber-White robust standard errors & covariance				
Random search: 25 starting values with 10 iterations using 1 standard deviation (rng=kn, seed=759803832)				
Failure to improve objective (non-zero gradients) after 0 iterations				
Variable	Coefficient	Std. Error	z-Statistic	Prob.



Regime 1				
C	2.504451	0.26791	9.348118	0.0000
URDOT	-2.67959	0.227694	-11.7684	0.0000
LOG(SIGMA)	1.15424	0.059862	19.28158	0.0000
Regime 2				
C	10.10899	0.278098	36.35047	0.0000
URDOT	0.781117	0.230946	3.382254	0.0007
LOG(SIGMA)	0.024354	0.197196	0.1235	0.9017
Common				
NEERDOT	-0.05749	0.00847	-6.7881	0.0000
MSRDOT	0.088174	0.010426	8.456804	0.0000
DVRDOT	0.014431	0.005205	2.772773	0.0056
CXRDOT	0.02215	0.007393	2.996101	0.0027
Probabilities Parameters				
P1-C	1.532427	0.184805	8.29213	0.0000
Mean dependent var	4.071894	S.D. dependent var		5.187634
S.E. of regression	4.794682	Sum squared resid		5011.596
Durbin-Watson stat	0.42	Log-likelihood		-633.891
Akaike info criterion	5.656937	Schwarz criterion		5.822388
Hannan-Quinn criteria.	5.723692			

## Annex (6)

Variables	Simple Switching Regression		Markov Switching Regression	
	Regime 1	Regime 2	Regime 1	Regime 2
Constant	2.504***	10.109***	0.517***	3.388***
Unemployment Rate	-2.680***	0.782***	-0.593***	-1.154**
Non-switching Regressors				
Development Expenses	0.014***		0.027***	
Current Expenditure	0.022***		-0.028***	
NEER	-.058***		5.876149***	
Real Money Supply	0.088***		-0.183***	
LOG(SIGMA)	0.027***		-0.073***	1.759929***
Probability Parameter	1.532***		-5.043***	-0.989
Transition Matrix	P1	P2	P1	P2
P1	0.822	0.178	0.006	0.994
P2	0.822	0.178	0.402	0.598
Duration	5.627	1.216	1.006	2.490
AIC	5.94		5.89	