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Business Cycles and Growth Regime Transitions in Morocco: Evidence from a Markov-Switching Model

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Abstract. Economic growth in Morocco shows pronounced fluctuations over the long run. Understanding the structure of these fluctuations requires identifying shifts in the underlying growth process. This paper tests whether Moroccan growth is generated by a single stable data-generating process subject to symmetric shocks, or by structurally distinct regimes with different volatility and persistence properties. This paper examines the determinants and dynamics of Moroccan economic growth over the period 1966–2018 using a Markov-Switching Mean and Variance model with exogenous regressors (MSM(H)-X). A formal likelihood-ratio test strongly rejects the linear single-regime specification in favor of a two-regime model, revealing two distinct regimes. The first corresponds to a stable growth phase characterized by low volatility and high persistence (average duration of about 4.8 years). The second reflects a volatile regime marked by rapid fluctuations and stronger exposure to external shocks (average duration of about 3.5 years). Regime-specific volatilities differ by a factor of more than four ($\sigma_2/\sigma_1 \approx 4.15$), with non-overlapping confidence intervals, providing strong evidence of regime-dependent dynamics. The estimated regimes broadly correspond to the cycles identified by the Hodrick–Prescott filter; the concordance, formally quantified through the hit ratio and Cohen's kappa coefficient, provides external validation of the probabilistic regime classification. Within the MSM(H)-X framework, agricultural output and total factor productivity are significantly associated with national growth. Deterioration in the trade balance exerts a negative influence on economic expansion, highlighting the economy's sensitivity to external imbalances. Estimated transition probabilities indicate strong persistence in the stable regime, whereas episodes of turbulence tend to be short-lived. The results provide evidence of structurally distinct growth regimes in Morocco's growth dynamics and offer a clearer probabilistic characterization of the country's cyclical trajectory over several decades.

Keywords: *Economic growth; Business cycles; Markov-switching model; MSM(H)-X; Macroeconomic volatility; Morocco.*

1. Introduction

Economic growth does not evolve along a smooth deterministic path. Fluctuations interrupt expansion, persistence varies across episodes, and shocks propagate differently depending on the state of the economy. Early empirical work treated business cycles as recurrent but broadly stable deviations around trend (Burns & Mitchell, 1946). The rational expectations revolution shifted attention toward equilibrium responses to shocks, emphasizing propagation mechanisms within a stable structure (Lucas, 1977; Kydland & Prescott, 1982). Yet both strands of the literature maintained, in different ways, the idea of a single underlying process. The question of whether growth itself operates through distinct regimes—rather than through a stable mechanism subject to shocks—remains central to macroeconomic analysis.

The econometric literature has progressively moved away from linear representations toward models that allow for structural change and asymmetry. The contribution of Hamilton (1989) formalized the idea that macroeconomic dynamics can switch between latent states governed by a Markov process, with regime-dependent means, variances, and persistence. Subsequent work extended this framework along several dimensions. Time-varying transition probabilities allow regime changes to respond to economic conditions (Filardo, 1994; Bazzi et al., 2017). Models with evolving parameters capture gradual structural transformation (Morier & Teles, 2016). Regime-switching dynamic factor models identify common cycles and synchronization across economies (Camacho & Perez-Quiros, 2014). Recent empirical contributions apply these tools to emerging economies and document asymmetric phases of expansion and slowdown, with differences in duration, volatility, and propagation (Gomes et al., 2024; Basistha, 2025; Koshy Odasseril & Shanmugam, 2025). A related line of research has documented that recoveries from output collapses in emerging economies are typically slow and incomplete, suggesting that growth dynamics are themselves asymmetric and regime-dependent (Cerra & Saxena, 2008). A consistent result emerges: growth processes are often nonlinear, and the assumption of a stable data-generating mechanism obscures key features of macroeconomic dynamics (Pu et al., 2023).

Despite this progress, much of the applied literature continues to rely on linear filtering techniques to characterize cycles, particularly in country-specific analyses. Methods such as the Hodrick–Prescott filter (Hodrick & Prescott, 1997) or Baxter–King decomposition (Baxter & King, 1999) identify turning points and cyclical components but impose a stable structure on the data. The HP filter, in particular, has been the subject of important methodological criticism (Hamilton, 2018), as it can introduce spurious dynamics and impose end-of-sample distortions that do not arise from the underlying data-generating process. These methods describe whether those fluctuations arise from distinct regimes with different statistical properties. The distinction matters. If growth operates through multiple regimes, then persistence, volatility, and the role of shocks differ across states. In such a setting, a linear model blends two different things — genuine shifts in the economy's structure and ordinary random fluctuation — and can therefore give a misleading picture of how stable or how vulnerable the economy really is.

This issue is particularly salient in the Moroccan case. Existing studies document strong volatility linked to climatic shocks, the central role of agriculture, and exposure to external imbalances (Elguellab et al., 2014; Khalfaoui, 2015). Cycle dating exercises based on filtering methods identify recurrent expansions and slowdowns, often associated with drought episodes, oil shocks, or periods of macroeconomic adjustment. At the same time, structural analyses highlight limited productivity gains and a gradual shift toward services without full industrial transformation (High Commission for Planning [HCP], 2007; Dalvit & Díaz-Cassou, 2024). These contributions establish stylized facts. They do not address whether Moroccan growth is generated by a single stable process subject to shocks, or by structurally distinct regimes with different dynamics. The implicit assumption of parameter stability remains largely untested.

Morocco offers a setting where that distinction carries analytical weight. The economy combines strong climatic exposure, a historically significant agricultural sector, increasing integration into global markets, and gradual but incomplete structural transformation. Shocks linked to rainfall, commodity prices, or external financing conditions do not operate in a neutral environment. They interact with underlying structural features that may alter the propagation of fluctuations. In such a context, treating growth as a linear process risks masking regime-dependent behavior. Identifying whether expansions and slowdowns correspond to distinct states, rather than to symmetric deviations around trend, becomes essential for interpreting macroeconomic dynamics.

In this paper, we move beyond a descriptive characterization of Moroccan growth fluctuations to test whether the macroeconomic propagation of structural and external shocks is itself regime-dependent. We formulate two testable hypotheses that follow from the structural features of the Moroccan economy.

> **H1.** Moroccan growth is generated by structurally distinct regimes whose mean, volatility, and persistence differ significantly, and whose transitions are economically driven by agricultural shocks and external imbalances rather than by uniform macroeconomic propagation around a stable trend. This hypothesis follows from the close dependence of aggregate output on rainfall driven agricultural production and from the country's recurrent exposure to balance of payments pressures. If H1 holds, a single linear data-generating process should be statistically rejected in favor of a regime-switching specification, and transitions should align with identifiable structural episodes such as drought years, external adjustment phases, and commodity-price shocks.

> **H2.** The conditional volatility and persistence of aggregate growth, given the structural and external drivers (agricultural output, total factor productivity (TFP), and the trade balance), are regime-dependent, significantly higher and less persistent in the turbulent regime than in the stable one. This hypothesis follows from the observation that, in structurally exposed economies, shocks of given magnitude propagate differently depending on the underlying macroeconomic state. A drought episode or a terms of trade deterioration that is absorbed in a stable expansion phase may amplify into a sharp contraction during a regime of macroeconomic vulnerability. If H2 holds, the regime-specific variances and the persistence parameters of the autoregressive process should differ significantly across states.

Testing these two hypotheses requires an econometric framework that simultaneously identifies latent regimes, captures their distinct statistical properties, and allows the dynamics of growth to vary across states. The empirical strategy therefore proceeds in two steps. First, we extract cyclical fluctuations using the Hodrick–Prescott (HP) filter as a descriptive benchmark in order to establish a deterministic chronology of expansions and slowdowns and to confront it with the probabilistic regime chronology obtained from the structural model. Second, we estimate a Markov-switching autoregressive model with exogenous variables (MSM(H)-X) following Hamilton (1989), allowing the mean, variance, and persistence of growth to vary across latent regimes. The specification incorporates agricultural output, TFP, and the trade balance in order to capture climatic, structural, and external dimensions of Moroccan growth. We estimate transition probabilities, regime persistence, and the duration of each state.

The contribution of the paper is empirical and interpretative rather than methodological. The analysis does not introduce a new econometric framework. It uses a standard regime-switching model to test the assumption of parameter stability that underlies most existing studies on Moroccan growth and to provide a probabilistic, rather than purely descriptive, reading of the country's cyclical trajectory over more than five decades. By distinguishing between regimes, the paper provides a different reading of persistence, volatility, and the role of key drivers such as agriculture and external balance. More broadly, it contributes to the understanding of growth dynamics in emerging economies where climatic variability and external dependence may generate regime-dependent behavior rather than stable cyclical patterns.

The remainder of the article proceeds as follows. Section 1 presents the data and the methodological framework. Section 2 examines the cyclical behavior of the Moroccan economy. Section 3 reports the estimation results and evaluates the properties of the identified growth regimes. Section 4 discusses the empirical findings. The final section outlines the implications of the results and directions for further research.

2. Data and methodology

To analyze the dynamics of Moroccan economic growth, we combine two complementary empirical approaches. First, we apply the HP filter to decompose real GDP into a long-run trend component and a cyclical component. This decomposition isolates short-term fluctuations around the growth trajectory and. allows us to date phases of expansion and contraction around the long-term growth path. The dating is deterministic in the sense that, once the smoothing parameter is fixed, the filter assigns each year to an expansion or a contraction mechanically, without any probability attached to that assignment. As a descriptive benchmark, the HP filter provides a useful starting point, while recognizing the well-documented limitations of two-sided filters in introducing spurious dynamics and end of sample distortions (Hamilton, 2018).

Second, we estimate a Markov-Switching Mean and Variance model with exogenous regressors (MSM(H)-X) following the framework introduced by Hamilton (1989) and systematized by Krolzig (1997). This specification allows the conditional mean, the variance, and the autoregressive coefficients to vary across latent regimes governed by a first-order Markov chain, while the marginal effects of the exogenous explanatory variables (agricultural output, TFP, and the trade balance) are assumed constant across regimes. This restriction is consistent with our research design: H1 tests whether the unconditional properties of the growth process (mean, volatility, persistence) differ across regimes, while H2 tests whether the conditional volatility and persistence of the growth process, given a set of structural and external drivers, are themselves regime-dependent. Allowing the autoregressive coefficients and the variance to switch across regimes, while keeping the marginal effects of the regressors stable, captures these features parsimoniously without overburdening a model estimated on a relatively short annual sample.

Combining these two approaches provides a coherent framework for examining the cyclical behavior of the Moroccan economy. The HP filter produces a deterministic dating of cyclical phases. The Markov-switching model, by contrast, identifies regimes endogenously through probabilistic inference. By confronting the deterministic chronology obtained from the filtering procedure with the regime structure estimated in the MSM(H)-X model, we obtain a robust empirical framework for assessing nonlinear growth dynamics and regime transitions in Morocco.

a. Data Sources and Variables

We use annual observations covering 1966–2018 (Table A1 in the Appendix). The explanatory variables capture three dimensions of Moroccan growth dynamics: cyclical–climatic conditions, structural productivity, and external balance. This structure fits the objective of identifying regime transitions within a Markov-switching framework.

We first account for short-run fluctuations driven by climatic conditions. Agricultural GDP enters the specification because agricultural output has historically shaped Moroccan business cycles. Rainfall variability affects harvests and transmits quickly to aggregate activity, which makes agricultural production a key channel through which climatic shocks influence growth.

We then introduce a structural dimension through TFP, which captures productive efficiency and technological progress. As a standard proxy for long-run growth drivers in studies of emerging economies, it reflects deeper transformations in the production structure.

We finally incorporate the external dimension through the trade balance. We prefer this indicator to measures such as terms of trade or openness ratios because it directly reflects the external macroeconomic constraint. The trade balance summarizes export performance, import dynamics, and the import content of domestic demand. Its inclusion allows us to capture external shocks and their role in shifts between growth regimes. Thus, the set of variables captures the main forces shaping Moroccan growth while remaining parsimonious, which is essential for regime-switching estimation with relatively long historical series.

b. Cyclical decomposition of the economy: HP filter

We use the HP filter to separate the long-run trend of output from its cyclical fluctuations. The method smooths the series and decomposes the logarithm of real GDP (y_t) into a non-stationary trend component (y_t^p) and a stationary cyclical component (y_t^p,). The decomposition takes the following form:

$$y_t = y_t^p + y_t^c.$$

The trend is determined by minimizing a program that establishes a trade-off between the fit to the observed data and the smoothness of the trajectory:

$$\underset{y_t^*}{\text{Min}} \sum_{t=1}^{T} (y_t - y_t^*)^2 - \lambda \sum_{t=2}^{T-1} [(y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*)]^2$$

Where y_t^* denotes the logarithm of smoothed GDP. The parameter λ represents the Lagrange multiplier that regulates the relative importance of variations in the trend compared with cyclical deviations. Formally, λ corresponds to the ratio of the variances of the trend and the cycle σ_p^2/σ_c^2, and it determines the degree of smoothing: the larger the value of λ, the smoother the trend becomes, approaching a deterministic trajectory. The mathematical program can be rewritten as follows:

$$\underset{y_t^*}{\text{Min}} \quad \sigma_p^{-2} \sum_{t=1}^{T} (y_t - y_t^*)^2 - \sigma_c^{-2} \sum_{t=2}^{T-1} [(y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*)]^2$$

Where σ_p^{-2} denotes the variance of the trend component y_t^p and σ_c^{-2} denotes the variance of the cyclical fluctuations y_t^c.

The method ensures a coherent separation between transitory fluctuations and structural growth. It maintains a practically stable dating of cyclical phases. For annual series, Hodrick & Prescott recommend λ=100. For quarterly series they propose λ=1600. Such values maintain an appropriate balance between the trend and the cycle.

c. Growth Regime Modeling: MSM(H)-X Model

In the general specification of the MSM(H)-X model with P regime-dependent autoregressive terms, the dependent variable y_t at time t is expressed as follows:

$$y_t = \mu_{S_t} + X_t\alpha + \sum_{i=1}^{p} \phi_{i,S_t}\left(y_{t-i} - \mu_{S_{t-i}}\right) + \varepsilon_{S_t}$$

where y_t denotes the dependent variable at time t. The term μ_{S_t} represents the regime-dependent constant, capturing differences in the average growth level across regimes. The vector X_t contains the exogenous explanatory variables, agricultural output, TFP, and the trade balance, whose marginal effects α are assumed invariant across regimes. The parameters ϕ_{i,S_t} are the regime-dependent autoregressive coefficients, they measure how strongly growth in a given regime carries over from one year to the next.

The error term ε_{S_t} is assumed to independent and identically distributed, normal, with zero mean and a regime-specific variance, $\varepsilon_{S_t} \sim \mathrm{N}(0, \sigma^2_{\mathrm{St}})$. In the terminology of Krolzig (1997), this specification corresponds to an MSM(H)-X model, that is, a Markov-switching model with exogenous regressors in which both the mean (M) and the variance (H, denoting heteroskedasticity) are regime-dependent, while the marginal effects of the regressors stay constant.

This specification fits our research question for three reasons. First, it lets us test H1 with a likelihood-ratio comparison between the two-regime model and its single-regime (linear) restriction. Second, it lets us test H2 by checking whether the regime-specific variances σ^2_{St} and the persistence parameters ϕ_{i,S_t} differ across regimes. Third, holding the marginal effects α fixed across regimes saves degrees of freedom: on a 52-year annual sample, a model that also let α switch (a fully regime-switching MSM(H)-X) would be hard to identify.

The model assumes the existence of distinct economic growth regimes, with transition probabilities considered constant over time. The associated Markov chain is described by the transition matrix (example of a two-regime model):

$$P = \begin{pmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{pmatrix} \quad \text{With} \quad \begin{cases} p_{11} = 1 - p_{12} \\ p_{22} = 1 - p_{21} \end{cases}$$

Here p_{ii} is the probability of staying in regime i from one year to the next, which measures how persistent each state is. The expected duration of regime i equals $1/(1- p_{ii})$, so the two values can be compared directly to see how much longer stable phases last than turbulent ones. We estimate the model by maximum likelihood using the Hamilton (1990) algorithm. We report the filtered and smoothed regime probabilities, the estimated transition probabilities, the average duration of each regime, and the asymmetry between the stable and turbulent growth phases.

d. Estimation Strategy and Validation

We begin with a set of pre-estimation diagnostics to ensure that the empirical specification is econometrically valid. Stationarity tests constitute the first step. The MSM(H)-X framework requires stationary series so that regime shifts capture genuine structural changes in growth dynamics rather than stochastic trends. Stationarity ensures that differences in mean and volatility across regimes remain economically interpretable and that transition probabilities and parameter estimates are not distorted.

We then examine the correlation structure among the variables. This step helps detect multicollinearity, a situation in which two regressors move so closely together that the model cannot separate their individual effects, inflating the standard errors and making the coefficients unstable. It also gives a first view of how each explanatory variable relates to growth. We next specify an autoregressive structure in the growth equation. The autoregressive component captures persistence within each regime and separates intra-regime dynamics from transitions across regimes. Including this term matters because, without it, ordinary year-to-year persistence in growth could be misread as a switch from one regime to another. Finally, we determine the optimal number of regimes by balancing model fit with parsimony, ensuring that the selected specification captures regime heterogeneity without unnecessary complexity. The choice between a two-regime and a three-regime specification is informed by information criteria (AIC, BIC, HQIC) and the likelihood-ratio test of regime non-linearity, with the latter testing the null of a single regime — the formal test of H1.

After estimating the model, we conduct several diagnostic tests to evaluate the reliability of the results.

We reassess multicollinearity among regressors and examine the distribution of residuals in order to evaluate the symmetry and normality of the error term. We then test residual autocorrelation across multiple lags to verify the absence of remaining serial dependence. These diagnostics allow us to assess whether the residual process behaves as white noise and whether the econometric specification adequately captures the dynamics of the data.

To assess model robustness, we conduct stability and sensitivity analyses. The two-regime MSM(H)-X model is re-estimated over a reduced sample (1970–2010) and compared with an alternative three-regime specification to evaluate the stability of regime classification and determine whether an additional extreme growth regime emerges. These post-estimation checks assess the persistence of transition probabilities and confirm that the two-regime MSM(H)-X model provides a stable and reliable characterization of Morocco's growth dynamics.

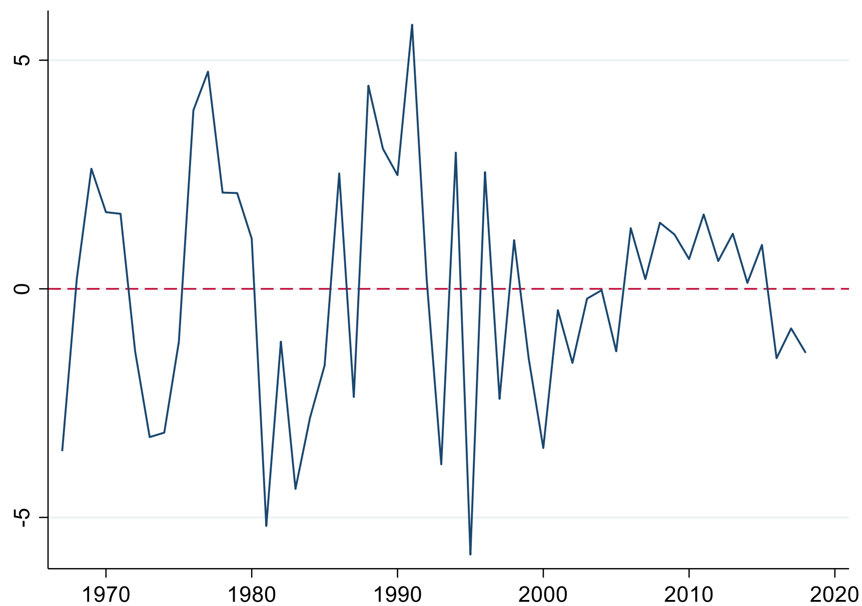
3. Business Cycle Analysis in Morocco

We examine Moroccan growth over the period 1966–2018 to identify the main sources of volatility and the forces shaping its trajectory. The analysis focuses on three dimensions: cyclical fluctuations linked to climatic conditions, structural drivers associated with long-term productivity, and external influences related to market shocks and macroeconomic imbalances. The HP-filter decomposition presented in this section serves as a descriptive benchmark, providing the deterministic cycle dating that will be confronted with the probabilistic regime classification of the MSM(H)-X model.

a. Identification of Cycles: Results from the HP Filter

We extract the cyclical component of real GDP using the HP filter over the period 1966–2018. The resulting series reveals a growth pattern shaped by recurrent exogenous shocks and structural adjustments. Over the full sample, Moroccan economic growth averages close to 4 %. Volatility appears stronger during the 1970s and 1980s, whereas fluctuations become more moderate from the early 2000s onward, suggesting a gradual stabilization of macroeconomic dynamics. This descriptive pattern is a first indication to be tested more formally in Section 3, that Moroccan growth may not be generated by a single stable process but rather by structurally distinct regimes with different volatility properties.

Figure 1: Economic Growth Cycles in Morocco



Source: Authors

Figure 1 shows several turning points in Morocco's growth trajectory. We observe an initial expansion between 1966 and 1974, followed by a sharp interruption linked to the macroeconomic imbalances that emerged after the first oil shock. The period 1975–1987 displays pronounced instability associated with the debt crisis and the implementation of the structural adjustment program (El Malki, 1989; Achiq et al., 1998; Baraka & Benrida, 2006).

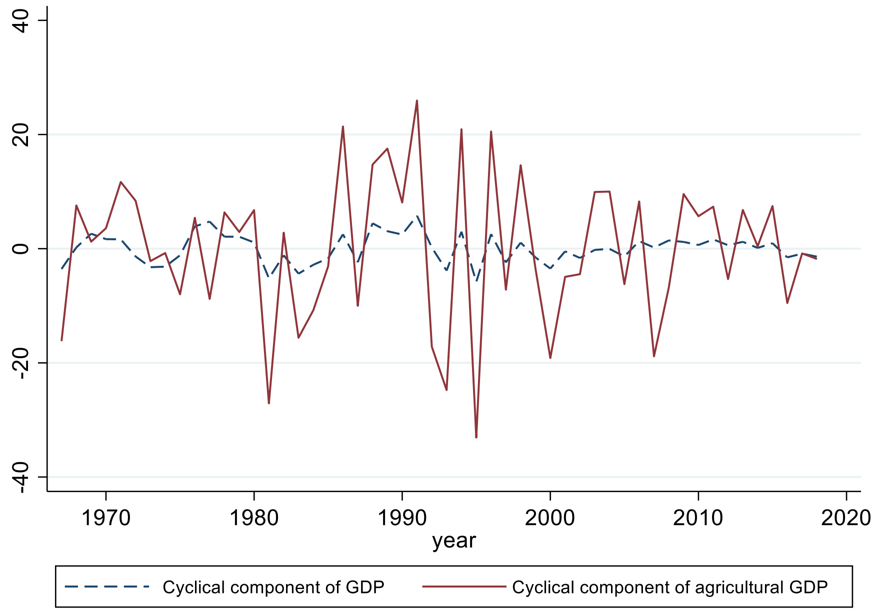
We observe a recovery from 1988 through the late 1990s. Growth accelerates further in the early 2000s, particularly during the 2001–2005 cycle (Khalfaoui, 2015). The period 2006–2016 introduces a visible shift. Growth remains positive but moderates, with expansion supported largely by public investment and structural reforms (OECD, 2024).

b. Macroeconomic Volatility and the Role of Agriculture

Morocco's business cycle remains closely tied to fluctuations in the agricultural sector, largely because agricultural output depends heavily on climatic conditions. Over the period 1966–2018, the correlation between aggregate GDP and agricultural GDP reaches 0.830, which indicates the central role of agriculture in transmitting macroeconomic shocks.

Rainfall variability remains the main source of this volatility. Empirical evidence shows that drought episodes can reduce cereal production by up to 40 %, generating sizeable fluctuations in aggregate output (OECD, 2020). Such patterns indicate that Moroccan growth continues to reflect a structural exposure of the agricultural sector to climatic shocks.

Figure 2: GDP Gap and Agricultural GDP Gap



Source: Authors

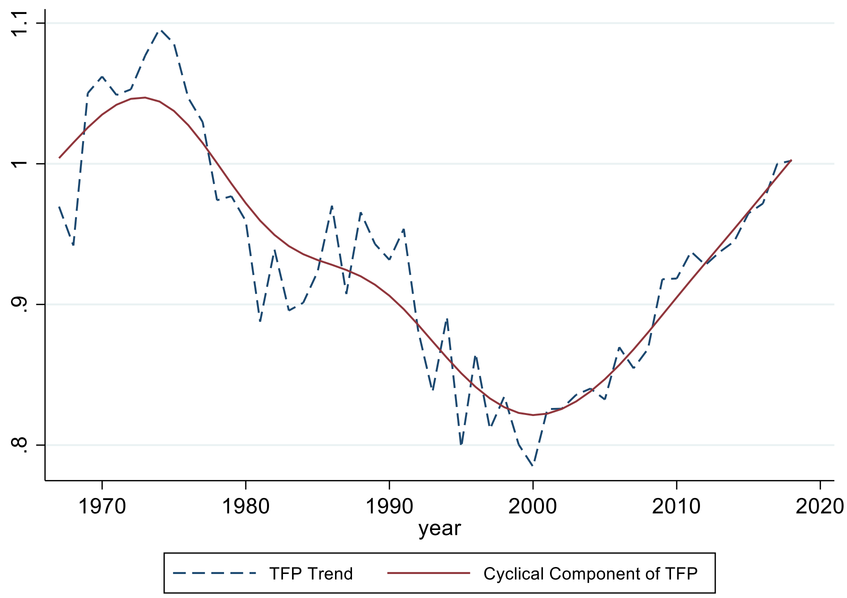
Figure 2 reports deviations of total GDP and agricultural GDP from their respective trends. We observe pronounced volatility in agricultural output and a close alignment between agricultural fluctuations and aggregate cyclical movements. Agriculture contributes a relatively modest share of total GDP over the period, between 13 and 23 %, yet its weight in the economy remains substantial. The sector employs close to 40 % of the labor force and accounts for a significant share of exports (Ministry of Agriculture and Maritime Fisheries, 2016). The HP decomposition highlights the impact of climatic shocks. Recurrent drought episodes — 1981, 1983, 1987, 1992, 1995, 1997, 1999, 2000, 2005, 2007, and 2016 — lead to sharp contractions in agricultural output and transmit rapidly to aggregate activity. From the mid-1990s onward, non-agricultural GDP displays greater stability, which reflects a gradual diversification of the productive structure. These observations motivate the inclusion of agricultural output as a key explanatory variable in the MSM(H)-X model and support our first hypothesis that transitions between growth regimes are economically driven by agricultural shocks.

c. Long-Run Structural Dimension: TFP and Output Gap Analysis

Table A3 (Appendix) reports the coefficients of variation across sectors and reveals substantial differences in volatility within the Moroccan economy. Real GDP exhibits moderate volatility, with an average coefficient of 0.063. Agricultural output shows significantly larger fluctuations, with an average coefficient of 0.099 and pronounced peaks during 1982–1987 (0.172) and 1988–1995 (0.190). These values confirm the strong sensitivity of economic activity to climatic shocks.

Industrial and service sectors display more stable dynamics. Their average coefficients of variation reach 0.052 and 0.057, respectively, which indicates comparatively smoother fluctuations in non-agricultural activity.

Figure 3: Fluctuations of TFP around its long-run trend



Source: Authors

Figure 3 shows pronounced fluctuations of TFP around its long-run trend throughout the sample period. Table 1 indicates a sharp contraction in TFP growth between 1975 and 1981 (–2.96 %), followed by a moderate recovery during the 1980s and 1990s. Productivity improves gradually after 2000. Growth reaches 1.19 % during 2001–2005 and 1.44 % during 2006–2018. Despite this improvement, the long-run contribution of TFP to Moroccan growth remains limited. Expansion continues to rely largely on factor accumulation rather than sustained gains in productive efficiency.

We measure cyclical pressure through the output gap, defined as the difference between observed GDP and its trend component. When the gap is close to zero, the economy is producing roughly at its potential. A persistently positive gap points to overheating, while a persistently negative gap points to slack and unused capacity; both signal macroeconomic imbalance (Blanchard & Sheen, 2013).

Table 1: Growth rates of the variables used

Growth	1966 1974	1975 1981	1982 1987	1988 1995	1996 2000	2001 2005	2006 2018	Mean
RGDP	6,23	4,69	5,22	3,30	4,09	4,88	4,09	4,50
TGDP	6,50	4,93	4,75	3,64	3,71	4,56	3,96	4,47
IGDP	5,83	5,04	1,49	2,85	3,77	3,82	3,05	3,56
AGDP	5,43	-2,25	7,51	-0,82	4,93	6,76	4,82	3,48
SGDP	_	_	4,33	3,72	3,98	5,02	3,86	3,12
NAGDP	6,47	6,21	4,85	3,93	3,99	4,63	3,98	4,72
TFP	1,51	-2,96	0,37	-1,59	-0,34	1,19	1,33	0,06
TO	1,00	-0,02	-1,71	1,23	1,95	2,24	1,48	0,91
TOTA	21,58	-10,4	23,77	3,78	-5,12	-8,42	13,67	2,98
TB	19,86	75,93	-4,31	12,05	1,68	7,80	9,43	15,64

Note: RGDP: real GDP; AGDP: agricultural GDP; IGDP: industrial GDP; NAGDP: non-agricultural GDP; SGDP: services GDP; TO: trade openness; TOTA: terms-of-trade adjustment; TB: trade balance.

Source: Authors' calculations

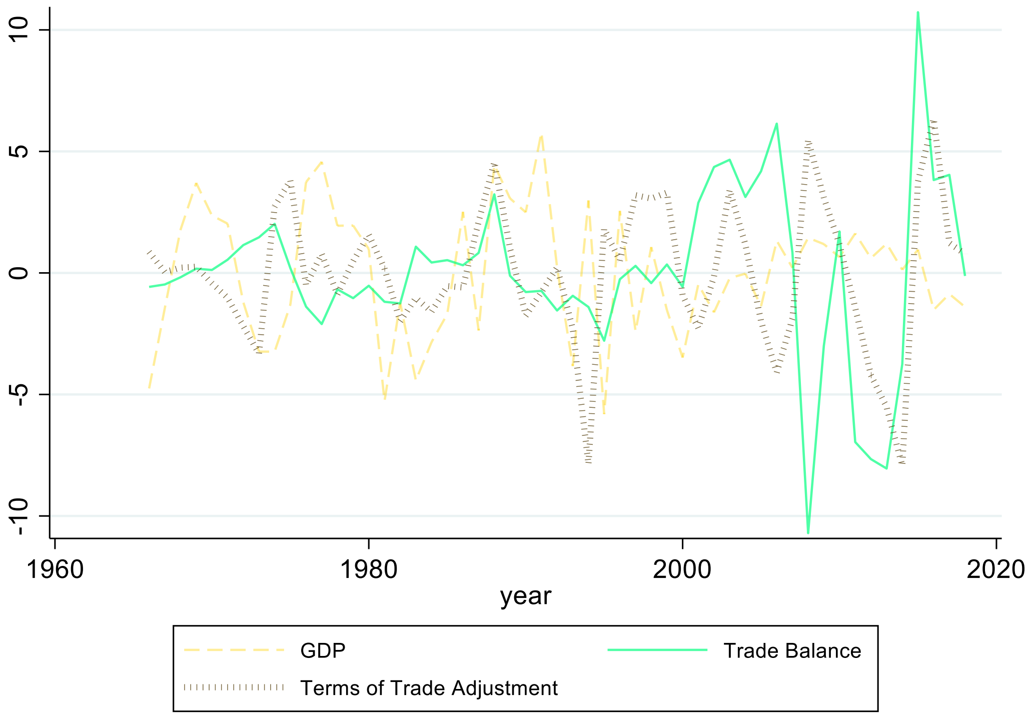
Potential growth declines gradually over the sample period (Table 1). It exceeds 6 % during 1966–1974 and falls to roughly 4 % from the 2000s onward. The slowdown reflects the limited contribution of TFP, a pattern documented in analyses by the High Commission for Planning (HCP, 2007) and Dalvit and Díaz-Cassou (2024).

The output gap remains relatively small in most years, with deviations from potential output generally below 2 %. A clear break appears in the early 1980s. During this period, actual output falls significantly below its potential level, reflecting the macroeconomic constraints associated with the Structural Adjustment Program.

d. External Dimension and Market Shocks

Morocco's global integration has strengthened the transmission of external shocks, which makes the analysis of the trade balance and the adjustment of the terms of trade essential. Data for both indicators are available over the entire time horizon considered.

Figure 4: Cyclicality of GDP and External Trade Indicators



Source: Authors

Figure 4 shows a clear co-movement between the cyclical component of GDP and indicators of external trade. This suggests the sensitivity of Moroccan growth to fluctuations in global energy and commodity prices. We observe a structural deterioration in the trade balance. The deficit widens from −0.14 billion constant dollars during 1966–1974 to −12.28 billion during 2006–2018 (Table A2, Appendix). The trend reflects the rising import content of domestic demand and the impact of external shocks, including oil price shocks and the 2008 global crisis.

Terms-of-trade adjustments display substantial variation over time. The balance moves from −429 million constant dollars in 1966–1974 to 622 million during 1975–1981, and reaches higher levels during subsequent expansion phases, particularly after the 1990s. Such patterns indicate that Moroccan growth remains closely tied to international market conditions, which constrains the depth of structural transformation in the economy. The deterioration of the trade balance and the volatility of terms of trade further support the second component of H1, that external imbalances, alongside agricultural shocks, are key drivers of regime transitions in Moroccan growth dynamics.

Together, the descriptive evidence presented in this section establishes three stylized facts: (i) Moroccan growth displays asymmetric volatility, with episodes of high turbulence interrupting longer phases of stability; (ii) agricultural shocks and external imbalances coincide systematically with the most turbulent periods; and (iii) productivity gains remain limited and do not appear to smooth the cyclical pattern. These observations motivate the regime-switching framework developed in Section 3, which formally tests whether these stylized facts arise from a single stable data-generating process or from structurally distinct growth regimes.

4. Estimation and Validation of Growth Regimes

a. Preliminary Tests: Unit Roots and Correlations

We begin by examining the stationarity of the variables using two complementary unit-root tests: The Augmented Dickey–Fuller (ADF) test and the Phillips–Perron (PP) test. Both procedures test the null hypothesis that the series contains a unit root against the alternative of stationarity.

We estimate the tests with a constant and one lag, which corresponds to the optimal lag length given the information criteria and the size of the sample. This step verifies the time-series properties of the variables before estimating the MSM(H)-X model.

Table 2: Results of stationarity tests

Variable (% change)	Test	T-statistic (Z(t))	Critical value (5%)	p-value
RGDP	ADF	-4.779	-2.407	0.0000
	PP	-11.020	-3.577	0.0000
AGDP	ADF	-7.258	-2.407	0.0000
	PP	-15.069	-3.577	0.0000
TFP	ADF	-5.496	-2.407	0.0000
	PP	-11.069	-3.577	0.0000
TB	ADF	-5.186	-2.407	0.0000
	PP	-7.336	-3.577	0.0000
TOTA	ADF	-4.405	-2.407	0.0000
	PP	-5.495	-3.577	0.0000

Source: Authors' calculations

The results (Table 2) indicate that, for all variables examined, the ADF and PP statistics are consistently lower than the critical values at the 1% significance level. The p-values, all equal to zero, lead to the rejection of the null hypothesis of a unit root. The results confirm that the series are stationary around a non-zero mean. Estimation of the MSM(H)-X model therefore proceeds within a robust econometric framework, since the stationarity conditions are fully satisfied. Linear correlation between the variables (Table 3) was estimated to assess direct relationships. Pearson correlation coefficients were calculated, and statistical significance was tested using the associated p-values.

Table 3: Correlation Test Results (Variables in percentage Change)

Variable 1	Variable 2	Pearson Coeff.	P-value
RGDP	**AGDP**	0.830	0.0000
RGDP	**TB**	-0.003	0.9830
TFP	**RGDP**	0.735	0.0000
TFP	**TOTA**	-0.0976	0.4868
AGDP	**TB**	-0.029	0.8318
AGDP	**TFP**	0.710	0.0000
TB	**TOTA**	0.0220	0.8756
TB	**TFP**	-0.090	0.5215
TOTA	**RGDP**	-0.1755	0.2088
TOTA	**AGDP**	-0.1957	0.1602

Source: Authors' calculations

The results indicate a strong positive correlation between real GDP growth and agricultural GDP growth, highlighting the decisive role of the agricultural sector in growth dynamics. TFP exhibits a positive and statistically significant correlation with economic growth, reflecting the importance of productivity gains.

The high correlation between agricultural GDP and TFP suggests a potential risk of multicollinearity when both variables are included jointly in the same model. By contrast, the trade balance and the terms-of-trade adjustment variable display weak and statistically insignificant correlations with the other variables, indicating a limited direct impact of external shocks on annual growth variations in the sample considered.

These correlations also raise an endogeneity concern that deserves discussion. Aggregate GDP and agricultural GDP are mechanically related: agriculture enters the national accounts identity, and TFP is computed as a Solow residual from aggregate output and factor inputs, which introduces a mechanical correlation with GDP growth. The trade balance, while less mechanically related, may respond contemporaneously to growth through import dynamics. We address this concern in three ways. First, all variables enter in growth rates, which mitigates spurious level correlations. Second, the autoregressive structure of the MSM(H)-X model absorbs contemporaneous co-movement attributable to common unobserved shocks. Third, the regime-switching framework focuses inference on changes in the conditional distribution of growth across states rather than on a structural causal interpretation of point estimates.

b. Model Selection: Lags and Number of Regimes

The selection of the optimal autoregressive order relies on the Ljung–Box (Q) statistics applied to different lags of the variable under study (Table 4). The autocorrelation (AC) and partial autocorrelation (PAC) coefficients are reported together with the Q statistics and the associated p-values in order to assess the statistical significance of temporal dependence.

Table 4: Autocorrelation Test Results

LAG	AC	PAC	Q	P-value
1	-0.4053	-0.4068	9.2068	0.0024
2	0.2733	0.1441	13.476	0.0012
3	-0.0365	0.1794	13.553	0.0036
4	-0.1681	-0.1849	15.234	0.0042

Source: Authors' calculations

The autocorrelation function over four lags indicates a clear temporal dependence in the growth rate. The first lag shows a pronounced negative coefficient, which signals rapid adjustment. The second lag turns positive and suggests an oscillatory pattern consistent with short-run catch-up following temporary shocks. The third and fourth lags remain weak. The partial autocorrelation function concentrates persistence in the first lag. The null hypothesis of white noise is rejected, which confirms the presence of an autoregressive structure. We therefore adopt a parsimonious AR (1) specification, consistent with the limited sample size and the nonlinear structure of the Markov-switching model.

We select the number of regimes by comparing the likelihood and the information criteria reported in Table 5: Akaike (AIC), Hannan–Quinn (HQIC), and Schwarz–Bayesian (SBIC). The preferred specification maximizes the likelihood while minimizing the information criteria. This procedure balances fit and parsimony. Additional regimes are retained only when the gain in likelihood outweighs the increase in model complexity.

Table 5: Comparison of Likelihood and Information Criteria

Model	Regime	Log-likelihood	AIC	HQIC	SBIC
m_1	**1**	-105.2629	4.1986	—	4.4216
m_2	**2**	-91.4428	3.9016	4.0455	4.2769
m_3	**3**	-86.2816	3.8954	4.1112	4.4583

Source: Authors' calculations

The information criteria show a clear improvement when moving from a linear specification (m1) to a regime-switching model. The two-regime specification (m2) minimizes HQIC and SBIC and improves the log-likelihood (LL = –91.4), which indicates the best balance between model fit and parsimony. The three-regime model (m3) receives stronger penalties from the same criteria. The additional regime raises the number of estimated parameters to sixteen without producing a sufficient gain in fit.

Formal test of H1. Comparing the linear specification (m1) and the two-regime specification (m2) provides a direct test of our first hypothesis, whether Moroccan growth follows a regime-dependent process rather than a stable linear one. The likelihood ratio statistic is computed as:

$$LR = 2 \times (LL_{\mathbf{m}_2} - LL_{\mathbf{m}_1}) = 2 \times (-91.44 - (-105.26)) = 27.64$$

Under the standard regularity conditions, LR follows a chi-square distribution. Because the test of regime non-linearity falls into a non-standard inference problem (the transition probabilities are unidentified under the null), we follow the bound proposed by Davies (1987) and Garcia (1998), and compare LR to the upper bound chi-square critical value with degrees of freedom equal to the number of additional parameters introduced by the regime-switching specification (four parameters: μ_2, σ_2, p_{11}, p_{22}). With four degrees of freedom, the 1% critical value is 13.28. The LR statistic (27.64) exceeds this conservative bound by a wide margin, leading to the strong rejection of the linear specification in favor of the two-regime MSM(H)-X model. This provides the first piece of empirical evidence supporting H1: Moroccan growth is generated by structurally distinct regimes rather than by a single stable process.

c. Estimation results

We retain a two-regime specification in order to capture distinct phases of economic growth with different levels, dynamics, and volatility. We estimate the model by maximum likelihood **using the** Hamilton (1990) algorithm. The procedure produces filtered and smoothed probabilities of regime membership, along with the unconditional transition probabilities between regimes.

$$y_t = \mu_{S_t} + X_t\alpha + \phi_{S_t}\left(y_{t-1} - \mu_{S_{t-1}}\right) + \varepsilon_{S_t}$$

The model includes an AR (1) term for growth y_t, which captures year-to-year persistence within each regime. The three explanatory variables X_t, agricultural GDP, TFP, and the trade balance, enter in growth rates.

Table 6: Results of the MSM(H)-X estimation

Variable	Coeff.	S. E.	P-value	95% C.I.
AR (1)	0.5080	0.1243	0.000	[0.2643; 0.7517]
TFP	0.3253	0.0426	0.000	[0.2418; 0.4088]
AGDP	0.0999	0.0079	0.000	[0.0844; 0.1154]
TB	-4.6e-6	2e-6	0.023	[-8.5e-6 ; -6.3e-7]
Regime 1	3.6073	0.2732	0.000	[3.0717; 4.1428]
Regime 2	4.6375	0.8825	0.000	[2.9077; 6.3672]
σ_1	0.5961	0.1946	_	[0.3143 ; 1.1304]
σ_2	2.4717	0.4563	_	[1.7213 ; 3.5492]
p_{11}	0.7929	0.1243	_	[0.4647 ; 0.9441]
p_{21}	0.2878	0.1682	_	[0.0748 ; 0.6687]

Source: Authors' calculations

The estimates reveal a nonlinear pattern in Moroccan growth, characterized by asymmetric macroeconomic regimes.

i. Structural Determinants of Growth

Table 6 reports the estimated coefficients. The AR (1) term is positive and moderate (0.51), which indicates strong intertemporal persistence in growth. Current expansion partly reflects the momentum of the previous year. Agricultural growth and TFP emerge as the main drivers of output dynamics. Both variables display robust statistical significance. The coefficient associated with productivity growth (0.325) is consistent with the role of efficiency gains in shaping Morocco's growth path. By contrast, the trade balance exerts a negative influence. Its coefficient indicates that external imbalances are associated with a constraint on output expansion, a pattern consistent with the dependence of domestic activity on imported inputs and external financing conditions. As discussed in the preliminary tests section, these coefficients should be interpreted as conditional associations within the MSM(H)-X framework rather than as structural causal effects.

ii. Regimes and Volatility Asymmetry

The Markov-switching specification identifies two regimes that differ markedly in both mean growth and volatility. The first regime corresponds to moderate but stable growth, with an average rate of 3.61 % and limited volatility (σ_1 = 0.60). This regime captures persistent phases of steady expansion supported by agricultural performance and productivity improvements. The second regime displays higher average growth (4.64 %) but substantially greater volatility (σ_2 = 2.47). It corresponds to shorter, more turbulent episodes of rapid expansion exposed to external disturbances and accompanied by sharp macroeconomic adjustments, particularly through the external balance.

Formal test of H2. The regime-specific volatilities differ by a factor exceeding four (σ_2/σ_1 = 4.15), a difference that is statistically significant: the 95% confidence intervals of σ_1 ([0.31; 1.13]) and σ_2 ([1.72; 3.55]) do not overlap, allowing us to formally reject the null hypothesis of equal regime variances at conventional significance levels. The persistence parameters also display a clear regime asymmetry: the probability of remaining in the stable regime (p_{11} = 0.79) is exceeds the probability of remaining in the turbulent regime ($p_{22} = 1 - p_{21} = 0.71$), and the asymmetry in expected duration (4.83 versus 3.47 years) is even larger. Together, these results provide strong empirical support for H2: the conditional volatility and persistence of Moroccan growth are regime-dependent, with the turbulent regime characterized by substantially higher volatility and shorter persistence than the stable regime.

iii. Persistence and Transitions

The transition matrix reveals asymmetric persistence across regimes. The probability of remaining in the stable regime is high (p_{11} = 0.79), which implies relatively long periods of stability. The implied average duration reaches about 4.8 years (Table 7), computed as $1/(1-p_{11})$. The second regime is more transitory. The probability of moving from the volatile regime to the stable one remains limited (p_{21} = 0.29). High-volatility phases therefore tend to be shorter, with an average duration of about 3.47 years, and they rarely stabilize immediately without the absorption of external or macroeconomic shocks.

Table 7: Persistence Properties and Duration of Regimes

Regime	Number of Transitions	Mean Duration	Standard Deviation	Minimum	Maximum
1	8	4.83	4.51	1	13
2	7	3.47	2.38	1	6

Source: Authors' calculations

The distribution of observations across regimes shows a clear asymmetry. The first regime dominates the sample, accounting for 71 % of observations (37 out of 52), while the second regime represents 29 % (15 observations). We associate the first regime with stable growth conditions. Volatility remains low (σ_1 = 0.60) and persistence is high (p_{11} = 0.79). The regime therefore captures prolonged phases of steady expansion. The second regime reflects temporary instability. Volatility rises sharply (σ_2 = 2.47) and persistence declines (p_{21} = 0.29), which indicates shorter episodes associated with macroeconomic disruptions. Table 8 reports the dates of regime shifts identified by the MSM(H)-X model over the period 1966–2018.

Table 8: Chronology of Structural Breaks and Systemic Shocks

Obs.	Year	Regime	Duration
2.	1967	1	1
3.	1968	2	2
5.	1970	1	3
8.	1973	2	1
9.	1974	1	1
10.	1975	2	6
16.	1981	1	8
24.	1989	2	1
25.	1990	1	4
29.	1994	2	1
30.	1995	1	13
43.	2008	2	1
44.	2009	1	1
45.	2010	2	3
48.	2013	1	1

Source: Authors' calculations

Regime shifts align with major events in Morocco's economic history, including 1973, 1981, 1995, and 2008. The timing reflects the impact of external shocks—oil crises and global financial disturbances—as well as severe drought episodes. The two-regime structure therefore captures an asymmetric cyclical pattern. Stability constitutes the dominant state, whereas shorter but sharper volatility episodes interrupt the expansion path.

iv. Confronting the MSM(H)-X regimes with the HP cyclical chronology

A natural question is whether the deterministic HP-filter classification and the probabilistic regime assignment delivered by the MSM(H)-X model convey consistent information about Moroccan cyclical dynamics. Visual alignment is insufficient to settle this question; we therefore quantify the concordance using three complementary measures.

We define for each year a binary HP indicator: $HP_t = 1$ if the cyclical component is negative (below-trend phase), $HP_t = 0$ otherwise. Symmetrically, we define a Markov indicator: $MS_t = 1$ if the smoothed probability of State 1, the low-mean, low-variance regime, exceeds 0.5, $MS_t = 0$ otherwise. The mapping is motivated by the empirical content of State 1: its intercept (3.607, with standard error 0.273) lies below the sample-average growth rate, and its conditional standard deviation ($\sigma_1 = 0.60$) is four times smaller than that of State 2 ($\sigma_2 = 2.47$). State 1 thus captures the subdued-growth phase of the Moroccan economy, which partially overlaps with, but does not coincide with, the HP notion of below-trend output. Three concordance measures are computed over the estimation sample (1967–2018): the hit ratio, Cohen's kappa, and the Brier score.

Table 9: Concordance between HP-filter cycles and MSM(H)-X regimes, 1966–2018

Measure	Value	Interpretation
Hit Ratio (HR)	0.679	Share of years with identical classification
Cohen's K	0.374	Fair agreement corrected for chance (Landis & Koch, 1977)
Brier Score (BS)	0.215	Probabilistic forecast error (0 = perfect; 0.25 = uninformative)

Source: Authors' calculations

The two methods agree on roughly two-thirds of sample years (HR = 0.679). Cohen's K = 0.374 places the concordance in the fair-to-weak band (Landis & Koch, 1977; McHugh, 2012), reflecting the different unconditional frequencies of the two classifiers (47.2% under HP versus 73.1% under MSM(H)-X). The Brier score of 0.215, against an uninformative benchmark of 0.25, indicates that the smoothed probabilities carry moderate but non-negligible probabilistic information relative to the HP benchmark.

The pattern of disagreements is informative. The 2×2 cross-tabulation reveals strong asymmetry: 23 of the 25 HP below-trend years (92%) are also classified as State 1, whereas only 13 of the 27 HP above-trend years (48%) fall in State 2. The 14 years classified as above-trend by the HP filter but as State 1 by the Markov model constitute the main source of discordance. This asymmetry has two sources. First, the HP filter partitions the sample symmetrically around a smooth trend, so years only marginally above trend are recorded as expansions. Second, the Markov model identifies State 1 endogenously as the dominant *statistical* regime (73% of observations), not as a contraction phase, and therefore captures persistent moderate-growth years that the HP filter records as expansion. In this sense, the two classifications measure related but conceptually distinct objects: HP isolates symmetric cyclical deviations from a smooth trend, while MSM(H)-X identifies persistent statistical regimes that differ in their mean and volatility properties.

These results lend partial external validity to the MSM(H)-X regime identification: the model recovers a structure consistent with the conventional HP chronology in periods of clear below-trend output, while adding two dimensions the deterministic filter cannot represent, the degree of certainty attached to each classification, and the transition dynamics governing regime persistence.

d. Diagnostics and Robustness: Multicollinearity, Residuals, and Stability

We assess multicollinearity among regressors using the variance inflation factor (VIF). The statistic detects linear dependencies that may reduce the precision of coefficient estimates and distort their interpretation. In empirical practice, VIF values above 10 indicate a potentially serious multicollinearity problem.

Table 10: Results of the multicollinearity test (VIF)

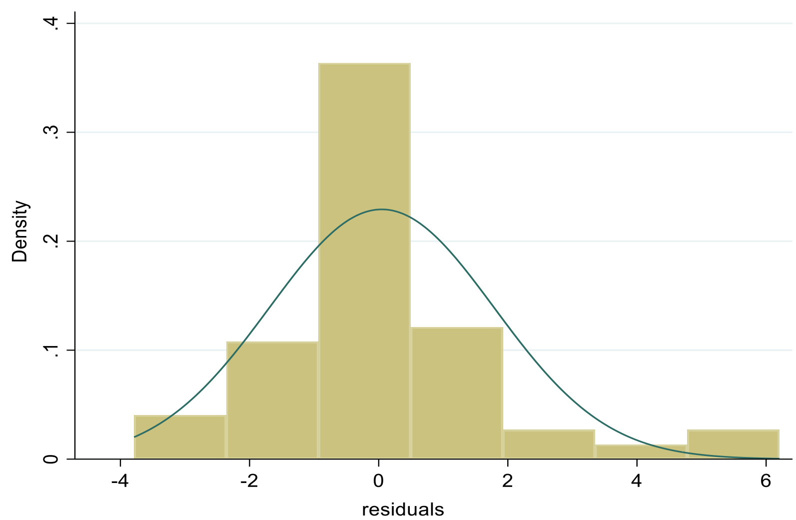
Variable	VIF	1/VIF
TFP	2.04	0.4906
AGDP	2.02	0.4942
TB	1.01	0.9895
Mean VIF	_	1.69

Source: Authors' calculations

The multicollinearity test applied to the explanatory variables (Table 10) yields very low VIF values, with an average of 1.69. These values remain well below conventional thresholds used in the literature. The result indicates the absence of significant collinearity among the regressors. The variables can therefore enter the specification jointly without generating coefficient instability, which supports the reliability of the estimated parameters.

We then examine the distribution of residuals in order to assess the adequacy of the model and the validity of statistical inference. We inspect the residual histogram to evaluate the symmetry of the distribution and its proximity to the normal distribution.

Figure 5: Residual Distribution

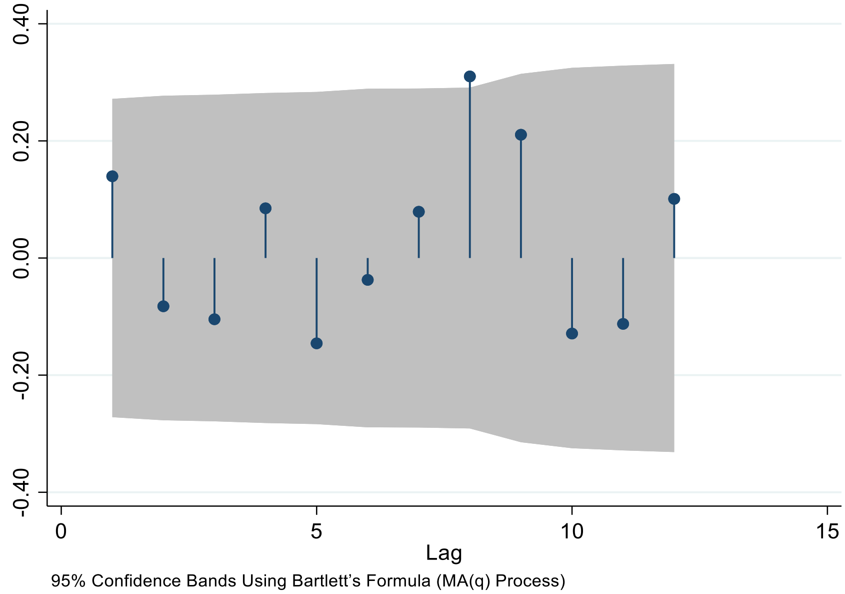


Source: Authors

Figure 5 presents the histogram of filtered residuals from the MSM(H)-X model, along with the normal density curve. The distribution remains centered around zero, with most observations lying between −2 and 2. The pattern indicates the absence of systematic bias in the model's errors. The shape approximates a normal distribution, although slight asymmetry and a few extreme values appear in the right tail. Overall, the residual distribution does not display substantial departures from normality. This pattern supports the adequacy of the MSM(H)-X specification and the statistical validity of the estimated coefficients.

We then examine residual autocorrelation using the correlogram (Figure 6) and the Portmanteau test. The correlogram provides a visual assessment of serial dependence, while the Portmanteau statistic evaluates the joint significance of autocorrelations across several lags.

Figure 6: Residual Autocorrelation Correlogram (ACF)



Source: Authors

The residual correlogram over 24 lags shows that all autocorrelation coefficients fall within the 95 % Bartlett confidence bands, with only a few values approaching the limits. The pattern indicates the absence of statistically significant serial correlation. The Portmanteau test applied to the first 12 lags confirms this result. The statistic reaches Q = 15.97 with a p-value of 0.19, which leads us not to reject the null hypothesis of no residual autocorrelation. The residual process therefore behaves as white noise.

Briefly put, the residual diagnostics indicate that the MSM(H)-X specification captures the temporal structure of Moroccan growth adequately. Residuals appear approximately normal and free of serial dependence, which supports the econometric reliability of the identified regimes.

We assess robustness through several stability checks. We first re-estimate the two-regime MSM(H)-X model on a reduced sample covering 1970–2010. This sub-sample explicitly excludes both the initial post-independence years and the most recent decade, thereby testing whether regime identification depends on the boundary observations and on episodes such as the Structural Adjustment Program (1983–1992) or the 2008 global crisis. We then compare the results with an alternative specification allowing three regimes in order to examine whether an additional extreme regime emerges in the growth dynamics.

Table 11: Comparison of MSM(H)-X estimation results

	Variables	Baseline Model	Reduced Sample Model	Three-Regime Model
Growth equation	**AGDP**	0.0999*	0.0765*	0.0832*
	TFP	0.3253*	0.4665*	0.4156*
	TB	-4.6e-6**	-3.9e-6**	-2.7 e-6
	AR (1)	0.5080*	0.5168*	0.0476
Constants	**Regime 1**	3.6073*	3.9144*	2.6895*
	Regime 2	4.6375*	4.5344*	4.1297*
	Regime 3	_	_	9.0449*
Volatility	**σ_1**	0.5961	0.4377	1.0103
	σ_2	2.4717	2.1917	0.8273
	σ_3	_	_	1.1229
Transition probabilities	**p_{11}**	0.7929	0.7335	0.8579
	p_{12}	0.2878	0.2456	0.1420
	p_{21}	_	_	0.0817
	p_{22}	_	_	0.8564
	p_{31}	_	_	1.3 e-7
	p_{32}	_	_	0.27971
Model statistics	**Log-likelihood**	-91.4428	-67.6578	-86.2815
	AIC	3.9016	3.8829	3.8954
	HQIC	4.0455	4.0356	4.1112
	SBIC	4.2769	4.3051	4.4583

Source: Authors' calculations

Table 11 shows that re-estimating the model on the reduced sample does not materially alter the relationships identified in the baseline specification. The coefficients of the explanatory variables retain both their sign and statistical significance, which confirms the stability of the underlying economic mechanisms. The AR (1) coefficient remains significant and nearly unchanged (0.51 in the baseline model against 0.52 in the restricted sample), indicating persistent growth dynamics.

The estimated regimes display similar stability. The first regime corresponds to moderate and relatively stable growth, with low volatility (σ_1 = 0.44–0.60). The second regime reflects expansion episodes characterized by higher volatility (σ_2 = 2.19–2.47). Transition probabilities reinforce this interpretation. The probability of remaining in the moderate regime remains high (p_{11} = 0.73–0.79), which indicates that Moroccan growth operates most of the time within a relatively stable regime, occasionally interrupted by more volatile expansion phases.

Estimating a three-regime model yields a third regime associated with higher average growth (9.04 %). The specification, however, weakens the stability of the dynamic structure. The autoregressive coefficient becomes small and statistically insignificant, while several explanatory variables lose significance. Transition probabilities appear less stable, and observations concentrate heavily in one regime. Because almost all observations fall into a single regime, the distinct states become hard to identify — a sign that the three-regime model has more parameters than the data can support.

Information criteria support this interpretation. Although AIC and HQIC remain close across specifications, the SBIC—more restrictive in the presence of additional parameters—clearly favors the two-regime model. The latter therefore provides a better balance between fit and parsimony.

In sum, the sensitivity tests indicate that the two-regime structure offers the most robust characterization of Moroccan growth dynamics. The specification captures nonlinearities, regime asymmetry, and regime-dependent persistence while maintaining a parsimonious and economically interpretable structure.

5. Results and discussion

The empirical evidence presented above provides direct support for our two hypotheses. H1 is corroborated by the likelihood-ratio test rejecting the linear specification in favor of the two-regime MSM(H)-X model, by the strong asymmetry of the estimated transition matrix, and by the alignment of regime shifts with identifiable structural episodes in Morocco's economic history (1973, 1981, 1995, 2008). H2 is corroborated by the more than fourfold difference in regime-specific volatilities ($\sigma_2/\sigma_1 = 4.15$, non-overlapping confidence intervals) and by the asymmetric persistence parameters (4.83 years in the stable regime against 3.47 years in the turbulent one). Together, these results confirm that Moroccan growth is not a stable process subject to symmetric fluctuations but a structurally segmented process whose volatility and persistence are themselves regime-dependent. The cyclical chronology obtained from the HP filter is broadly consistent with the probabilistic regime identification of the MSM(H)-X model (Table 9), providing an additional external validation. Seven cycles emerge over the period 1966–2018.

a. External shocks and the shift toward instability (1973–1983)

The first cycle, 1966–1974, corresponds to a phase of rapid expansion, with average growth close to 6.2 %. Agricultural performance and public investment during the second five-year plan (1968–1972) supported this expansion (Couvreur, 1968). The breakdown of the Bretton Woods system in 1971 and the first oil shock in 1973 altered external conditions and marked the end of this expansionary phase.

The following cycle, 1975–1981, coincides with a transition toward a more volatile regime. Oil price shocks in 1973–1974 and 1979 deteriorated Morocco's external position. The government responded by expanding public investment financed through external borrowing in anticipation of sustained phosphate revenues (Santucci, 1975). The collapse of phosphate prices between 1975 and 1978 (Oualalou, 1975), combined with the second oil shock and rising international interest rates, triggered a debt crisis. External debt increased from roughly 20 % of GDP in the early 1970s to more than 50 % in the early 1980s (El-Naggar, 1987). The regime-switching estimates capture this transition as a movement toward higher volatility, consistent with H2: the same magnitude of external shock generates a larger output response in the turbulent regime than in the stable one.

b. Debt crisis and structural adjustment (1982–1995)

The period 1982–1987 marks a major break in Morocco's growth trajectory. External debt exceeded 80 % of GDP in 1983, which forced the adoption of a Structural Adjustment Program under IMF and World Bank supervision (Harrigan & El-Said, 2009). Fiscal consolidation, trade liberalization, and tax reform followed. The immediate effect was a contraction of domestic demand and a temporary slowdown in economic activity (Harrigan & El-Said, 2010).

Reforms continued during 1988–1995 with the introduction of new fiscal instruments, including VAT, corporate taxation, and personal income taxation. Morocco deepened its integration into the multilateral trading system. Growth remained moderate, averaging about 3.3 %, largely because agricultural shocks continued to affect aggregate activity. Severe droughts in 1992 and 1995 illustrate the persistent sensitivity of the economy to climatic conditions (Stour & Agoumi, 2008).

c. Stabilization and sectoral transition (1996–2018)

After the mid-1990s, growth enters a more stable phase. The **MSM(H)-X** model identifies a prolonged stability regime between 1995 and 2008. Cycles during 1996–2000 and 2001–2005 benefit from improved macroeconomic management, including active debt restructuring and the creation of a foreign exchange market in 1996 (Baraka & Benrida, 2006). Growth strengthens and volatility declines. The expansion of the service sector and remittance inflows from Moroccan workers abroad contribute to this stabilization (Bank Al-Maghrib, 2008).

The final cycle, 2006–2016, reflects a strong increase in investment. Gross investment rises from 26.2 % to 33.8 % of GDP. The Moroccan economy remains relatively resilient during the 2008 global financial crisis. However, the current account deficit widens significantly and reaches 9.3 % of GDP in 2012, which reflects increasing dependence on imported energy and capital goods.

d. Structural characteristics: climatic vulnerability and external dependence

The synchronization between cyclical turning points derived from HP filtering and regime shifts estimated by the MSM(H)-X model, particularly around 1974, 1981, 1992–1995, and 2008, highlights the role of structural constraints and external shocks in shaping Moroccan growth dynamics. The strong correlation between aggregate GDP and agricultural output (0.830) reflects the central role of rainfall variability. Severe drought episodes in 1981, 1983, 1987, 1992, 1995, 1997, 1999, 2000, 2005, 2007, and 2016 coincide with transitions toward higher-volatility regimes, consistent with recent assessments of the Moroccan economy (OECD, 2024) and with the broader emerging-economy literature documenting asymmetric output dynamics in structurally exposed countries (Cerra & Saxena, 2008; Moolman, 2004).

Structural factors further limit growth performance. Productivity gains remain modest (HCP, 2007; Dalvit & Díaz-Cassou, 2024). At the same time, sectoral transformation reveals a gradual decline in the relative weight of the primary sector and the rise of services, which now account for roughly 55 % of GDP. This shift toward services takes place without a parallel build-up of large-scale industry. As a result, Moroccan growth remains exposed to fluctuations in international markets, including commodity price movements and global financial disturbances. Similar dynamics have been documented in other emerging economies exposed to external shocks (Moolman, 2004; Elguellab et al., 2014).

6. Conclusion

We examined Moroccan economic growth over the period 1966–2018 by combining deterministic cycle dating through the Hodrick–Prescott filter with a nonlinear Markov- MSM(H)-X. The empirical strategy was designed to test two hypotheses derived from the structural features of the Moroccan economy: that growth is generated by structurally distinct regimes whose transitions are economically driven by agricultural shocks and external imbalances (H1), and that the conditional volatility and persistence of growth are themselves regime-dependent (H2).

Both hypotheses receive strong empirical support. A likelihood-ratio test rejects the linear specification in favor of a two-regime model at the 1% significance level, providing direct evidence for H1. Regime-specific volatilities differ by a factor exceeding four, with non-overlapping 95% confidence intervals, and the asymmetry of expected durations (4.8 versus 3.47 years) confirms that persistence is itself regime-dependent, providing direct evidence for H2. The first regime dominates the sample and displays moderate, relatively stable, and highly persistent growth. The second regime shows higher average growth but much stronger volatility and shorter duration, which reflects greater exposure to external disturbances. The probabilistic regime chronology obtained from the MSM(H)-X model and the deterministic cycle dating provided by the HP filter display substantial concordance, as quantified by the hit ratio, Cohen's kappa coefficient, and the Brier score. This external validation lends robustness to the regime identification while highlighting that the probabilistic framework captures additional information on regime persistence and classification uncertainty that the deterministic filter, by construction, cannot represent. The stable regime is characterized by moderate and persistent growth, particularly during the late 1980s and the 1990s–2000s, while the volatile regime captures shorter episodes of higher but more turbulent growth associated with external shocks and macroeconomic adjustments. Within the MSM(H)-X specification, agricultural activity and TFP are significantly associated with growth in expansion phases, while the deterioration of the trade balance acts as a structural constraint on growth.

This paper contributes to the literature by combining deterministic cycle identification with probabilistic regime validation within a Markov-switching framework. This methodological integration addresses limitations of standard linear approaches that struggle to capture endogenous structural breaks and asymmetric fluctuations. By estimating regime transition probabilities and average regime duration we provided a direct measure of macroeconomic stability and extended the empirical literature on regime-dependent growth dynamics in emerging economies exposed to climatic and external shocks.

Our main findings highlight persistent structural vulnerabilities linked to climatic dependence and exposure to international market conditions. Although the Moroccan economy has experienced gradual diversification and improved macroeconomic management, limited productivity growth continues to constrain long-run expansion.

Three limitations of our empirical strategy deserve explicit mention. First, the MSM(H)-X specification keeps the marginal effects of agricultural output, TFP, and the trade balance constant across regimes; a richer specification allowing these coefficients to switch with the regime would provide a stronger test of regime-dependent transmission. The relatively short annual sample (52 observations) does not allow this extension without loss of identification. Second, the contemporaneous inclusion of TFP, which is itself computed as a Solow residual, generates a mechanical association with GDP growth; we mitigate this concern through the autoregressive structure of the model but cannot fully eliminate it. Third, the sample ends in 2018 and does not incorporate the COVID-19 shock or the 2022 commodity-price episode. Extending the sample to incorporate these recent disturbances constitutes a natural direction for future research.

Our results carry several policy implications. The asymmetric persistence of the two regimes, long-lived stability interrupted by short but violent turbulent episodes, suggests that policy interventions should focus on shortening the duration of volatile phases and lengthening the stable ones, rather than merely smoothing average growth. Strengthening productive resilience remains a central priority. Reducing climatic vulnerability requires targeted investment in water infrastructure and agricultural modernization, designed with a 3–5-year planning horizon to match the average duration of turbulent regimes (3.5 years). Furthermore, since 92% of HP-contraction years map to the stable regime while only 46% of expansion years map to the volatile one, early warning systems should prioritize the monitoring of rainfall deviations, terms-of-trade movements, and import dynamics to detect exits from the turbulent regime rather than predict its onset. At the same time, policies that promote innovation, human capital formation, and productivity gains are necessary to shift the growth model from factor accumulation toward efficiency-driven expansion. Managing external imbalances remains equally important. Strategies aimed at upgrading export structures and mitigating external shocks, through stabilization mechanisms such as reserve funds or climate-risk insurance, would help sustain periods of stability and reduce macroeconomic volatility.

7. Appendices

Table A1: List of Variables Used

Indicator	Definition
RGDP	Real GDP: Sum of the gross value added of all resident producers, plus taxes on products and minus subsidies not included in the value of products.
AGDP	Agricultural GDP: Includes forestry, hunting, fishing, crops, and livestock production (ISIC 1–5).
IGDP	Industrial GDP: Mining, manufacturing, construction, electricity, water, and gas (ISIC 10–45).
SGDP	Services GDP: Trade, transport, government services, financial, professional, and personal services (ISIC 50–99).
TFP	Total factor productivity: the share of growth not attributable to capital and labor.
Imports	Value of all goods and services received from the rest of the world, including merchandise, transport, insurance, and various services.
Exports	Value of all goods and services supplied to the rest of the world, including merchandise, transport, insurance, and various services.
TO	Trade openness: Indicator of integration into international trade, calculated as the ratio of the sum of imports and exports to GDP.
TB	Trade balance: Difference between exports of goods and services and imports of goods and services.
TOTA	The terms-of-trade adjustment (TOTA) corresponds to import capacity minus export capacity of goods and services at constant prices. Data are expressed in constant local currency.

Source: Authors

Table A2: Comparison of Volatility Using Coefficients of Variation

Variables	1966 1974	1975 1981	1982 1987	1988 1995	1996 2000	2001 2005	2006 2018	Mean

RGDP	0.12	0.08	0.09	0.06	0.04	0.06	0.14	0.06
Total GDP	0.14	0.09	0.08	0.08	0.05	0.06	0.15	0.07
IGDP	0.13	0.07	0.03	0.05	0.05	0.05	0.01	0.05
AGDP	0.09	0.10	0.17	0.19	0.12	0.10	0.18	0.10
SGDP	_	_	0.07	0.08	0.06	0.07	0.14	0.06
NAGDP	0.14	0.10	0.08	0.08	0.05	0.06	0.15	0.07
TFP	0.05	0.07	0.03	0.07	0.04	0.01	0.05	0.09
TOTA	-1.73	1.07	2.02	1.68	0.30	0.36	0.72	1.42
TB	-0.36	-0.28	-0.19	-0.45	-0.27	-0.60	-0.28	-1.27
TO	0.05	0.09	0.05	0.05	0.08	0.05	0.06	0.156

Source: Authors

Table A3: Cyclical Means of the Variables Used (in Constant US Dollars, Billions)

Cycle	**1966 1974**	**1975 1981**	**1982 1987**	**1988 1995**	**1996 2000**	**2001 2005**	**2006 2018**	**Mean**
RGDP	26.90	45.88	31.57	41.29	45.32	55.51	101.50	55.20
TOTA	-0.43	0.62	0.21	0.48	1.37	1.37	1.94	0.87
TO	54.70	61.44	53.86	56.38	58.12	66.69	76.96	62.66
TFP	1.04	0.99	0.92	0.90	0.82	0.82	0.93	0.93
TB	8.88	15.61	9.28	10.64	11.51	13.76	23.11	14.16
IGDP	6.70	7.97	5.18	6.52	6.39	7.46	13.75	8.22
AGDP	_	26.19	16.31	20.77	22.72	28.68	53.10	35.09
SGDP	20.21	37.91	26.39	34.77	38.93	48.05	87.75	46.98
NAGDP	8.88	15.61	9.28	10.64	11.51	13.76	23.11	14.16

Source: Authors

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