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Toward an Inflation Targeting Policy in Morocco: Analysis of Key Macroeconomic Aggregates through the Hodrick-Prescott Filter

Imane SAAD-ALLAH
Doctor in Economics and Management Sciences
Ibn Zohr University
Morocco

Abstract:
Morocco has expressed its intention to adopt an inflation-targeting (IT) monetary framework, addressing the limits of traditional approaches based on monetary aggregates or fixed exchange rates. International evidence shows that IT enhances price stability, credibility, and transparency. Successful implementation requires solid macroeconomic foundations and institutional readiness. This study examines Morocco's main aggregates using the Hodrick-Prescott filter to separate long-term trends from short-term cycles. By identifying structural growth and cyclical fluctuations, the analysis highlights periods of stable expansion and controlled inflation, providing insights into the country's preparedness for IT and emphasizing the role of macroeconomic stability as a prerequisite for an effective inflation-targeting policy.

Keywords : Moroccan economy, Hodrick-Prescott filter, Economic cycles, Long-term trends, Cyclical components

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1. Introduction

Morocco has expressed its intention to adopt an inflation-targeting (IT) monetary framework. This policy emerged as a response to the limitations of traditional approaches based on controlling monetary aggregates and maintaining fixed exchange rate regimes. International experience has demonstrated its effectiveness in achieving price stability and anchoring inflation expectations (Neumann, 1997). Countries that have successfully implemented inflation targeting, such as New Zealand, Canada, and the United Kingdom, have benefited from greater transparency, credibility, and monetary discipline.

In emerging economies, including Morocco, the shift toward such a regime represents not only a change in monetary strategy but also a structural transition requiring a sound macroeconomic foundation (Imane, 2023). The effectiveness of inflation targeting depends heavily on the initial economic environment and institutional readiness. Therefore, before implementing such a policy, it is essential to assess whether the country meets the necessary macroeconomic and structural preconditions that support its success. However, Morocco faces challenges in successfully implementing an inflation targeting policy (Imane, 2025).

In this context, the present paper aims to analyze the main macroeconomic aggregates of the Moroccan economy particularly inflation and GDP over the past decade, in order to evaluate the country's readiness to adopt an inflation-targeting framework. By applying the Hodrick-Prescott filter, the study decomposes these variables into their long-term trends and short-term cyclical components, providing insights into Morocco's structural stability and cyclical behavior.

This paper presents an analysis of Morocco's main macroeconomic variables using the Hodrick-Prescott filter. This econometric method makes it possible to distinguish long-term trends from short-term cyclical components within time series. The adoption of this approach is motivated by the need to better understand the structural and cyclical dynamics of the Moroccan economy, by differentiating sustained growth phases from temporary fluctuations. Applying the filter thus highlights underlying trends while capturing economic cycles, thereby providing a more accurate interpretation of the evolution of key aggregates such as GDP, inflation, and the exchange rate.

In this context, the paper is structured into two complementary subsections. Section 1 focuses on the presentation of the trend components of macroeconomic aggregates, providing an overview of the long-term trajectories of the variables under study. This section details the methodology used for data processing, explaining the selection of the Hodrick-Prescott filter parameters and the interpretation of the results obtained. The objective is to identify structural trends that reflect long-term economic transformations, while highlighting their implications for Morocco's economic growth, inflation, and external competitiveness.

The second section then examines the cyclical components of macroeconomic aggregates, corresponding to temporary deviations around the long-term trends. This section analyzes economic cycles by identifying phases of expansion and recession, as well as their interaction with economic policies and exogenous shocks.

2. Literature review

The economic crises that have affected several countries such as East Asia in 1997, Russia in 1998, Brazil in 1999, and Argentina in 2002 have often been attributed to the rigidity of their exchange rate regimes. This type of peg, by limiting monetary flexibility, encourages significant capital movements and increases the risk of currency depreciation, which has led many countries to turn away from it.

It is in this context that the inflation targeting policy emerged, designed to compensate for the ineffectiveness of traditional approaches based on the control of monetary aggregates and the fixing of the exchange rate. International experience has demonstrated its effectiveness (Neumann, 1997). However, its success depends on the prior existence of a flexible exchange rate regime, a condition put forward by several research (Masson et al., 1997). The exchange rate thus appears as a major determinant of price stability and the effectiveness of this monetary framework, both in Keynesian and monetarist models and in the empirical experiences of countries that have adopted it.

Inflation targeting differs from previous regimes by explicitly targeting an optimal inflation rate for the entire economy. Exchange rate flexibility allows the central bank to strengthen its independence, broaden its objectives, and improve its responsiveness. This flexibility becomes essential when the central bank faces a trade-off between stabilizing the exchange rate and controlling inflation. In such cases, the accumulation of conflicting objectives can erode the credibility of monetary policy and compromise the anchoring of expectations.

The literature on inflation targeting highlights two major macroeconomic conditions as prerequisites for establishing a credible monetary regime: initially low inflation and stable, responsive economic growth. Regarding low initial inflation, the International Monetary Fund's paper *"Establishing Initial Conditions in Support of Inflation Targeting"* emphasizes that a country "experiencing annual inflation rates of 15–25% for several years will be unable to rely solely on monetary policy to sustainably reduce inflation." Operating in an environment where inflation is already under control facilitates the anchoring of expectations, strengthens the credibility of the central bank, and reduces the transition costs toward an inflation targeting framework.

Similarly, recent research on 35 emerging economies by Romdhane et al. (2023) finds that the adoption of an inflation-targeting (IT) regime requires economies to exhibit robust macro-financial fundamentals from the outset, particularly contained inflation and institutional stability.

As for stable economic growth, it emerges as an equally essential foundation. Moderate, predictable growth and a non-extreme output gap allow the central bank to adjust its policy stance without constantly facing severe cyclical fluctuations that could undermine inflation anchoring. The study by Kuncoro et al. (2024) on Indonesia shows that an inflation-targeting framework is more effective when growth is less volatile and inflation is already low suggesting that an economy's responsiveness and resilience improve the feasibility of IT implementation.

In other words, initially low inflation and stable growth work hand in hand: the former anchors expectations, while the latter ensures that the macroeconomic trajectory allows monetary policy to operate without persistent constraints from imbalances. For a country like Morocco, analyzing the evolution of inflation and growth through key macroeconomic aggregates is thus essential to assess its readiness for the adoption of an inflation-targeting monetary regime.

3. Methodology

The analysis of the trend components of Morocco's macroeconomic aggregates relies on the use of the Hodrick-Prescott (HP) filter, an econometric method widely applied to decompose time series into two distinct elements: a long-term trend and a short-term cyclical component (Sakarya & de Jong, 2020). The choice of this filter for examining Moroccan economic aggregates is justified by its ability to isolate fluctuations in economic growth, inflation, and other key macroeconomic variables. This approach makes it possible to highlight the structural trends underlying the long-term evolution of the national economy. Such decomposition is essential for analyzing the determinants of potential growth, identifying structural shocks, and assessing the long-term impact of economic policies.

The Hodrick–Prescott filter is based on an optimization function that minimizes the sum of squared deviations between the observed values of a time series and its trend component, while simultaneously penalizing excessive fluctuations in the latter. In practical terms, it aims to determine a trend series that minimizes the following objective function :

$$\sum_{t=1}^{T}(Y_t - T_t)^2 + \lambda\sum_{t=2}^{T-1}[(T_{t+1} - T_t) - (T_t - T_{t-1})]^2 \qquad (01)$$

Where Y_t represents the observed value of the economic aggregate at time t, T_t is the estimated trend component, and λ is the smoothing parameter that controls the flexibility of the trend.

The application of the Hodrick–Prescott (HP) filter in this study allows the decomposition of Morocco's main macroeconomic aggregates into long-term trends and short-term cyclical components. In this approach, the smoothing parameter λ determines the flexibility of the trend higher values generate smoother long-term trajectories, while lower ones capture more short-term fluctuations. Following standard practice, a value of 1600 was used for quarterly GDP data. This method highlights Morocco's structural transformations, such as periods of sustained growth, stagnation, or disinflation, and identifies phases of economic overheating or underutilization. Prior to filtering, the selected macroeconomic variables were log-transformed to facilitate interpretation. A second smoothing stage, using a lower λ value, was applied to reduce statistical noise and refine the cyclical component. Overall, the HP filter provides a clearer understanding of Morocco's structural trends and cyclical dynamics, offering insights into the long-term effects of economic policy.

However, the analysis of the cyclical components of Morocco's macroeconomic aggregates is based on decomposing time series into long-term trends and short-term fluctuations, the latter representing the cyclical component. This approach isolates business cycle variations around the structural trajectory of key variables such as GDP, inflation, and the real exchange rate. Cyclical components capture deviations from the trend, providing an essential framework for understanding expansions, recessions, and stabilization phases.

The primary method used is the Hodrick–Prescott (HP) filter, which separates short-term cycles from long-term trends by minimizing a smoothing function. The smoothing parameter λ controls trend flexibility, with higher values producing smoother trends and lower values capturing more short-term variation; a conventional value of 1600 is used for quarterly data. For robustness, complementary techniques such as ARIMA, Kalman filters, and the Baxter–

King filter are also employed to validate the extracted cycles and identify co-movements among variables.

Once extracted, cycles are analyzed through indicators of amplitude, duration, and synchronization to assess their intensity, periodicity, and coordination across variables. This methodology highlights the main characteristics of Morocco's business cycles and provides insights into the effectiveness of economic policies in mitigating recessions and sustaining expansions.

4. Results

4.1 Presentation of the Trend Components of Macroeconomic Aggregates

The analysis reveals a continuous depreciation of Morocco's real exchange rate between 2015 and 2023, reflecting several underlying economic dynamics. This persistent decline may indicate a weakening of the country's competitiveness, possibly driven by higher domestic inflation relative to key trading partners. Such a price differential makes Moroccan exports relatively more expensive, reducing their attractiveness abroad. The trend may also stem from structural imbalances in the balance of payments, particularly a persistent trade deficit. When imports consistently exceed exports, downward pressure on the real exchange rate arises, especially if financed through increased borrowing or the depletion of foreign reserves. Moreover, expansionary fiscal or monetary policies such as low interest rates stimulating domestic demand—can further depreciate the real exchange rate by encouraging capital outflows. External factors, notably fluctuations in energy and agricultural commodity prices, also play a role, as Morocco's dependence on energy imports makes its currency vulnerable to rising global prices.

The analysis of Morocco's nominal exchange rate from 2015 to 2023 reveals a U-shaped pattern, with an initial depreciation of the dirham followed by a gradual recovery after 2020. The early decline was mainly driven by a persistent trade deficit, expansionary monetary policies, and higher domestic inflation, which weakened the currency's value. From 2020 onward, the dirham appreciated due to monetary and structural reforms, improved trade performance particularly in agriculture, phosphates, and tourism and renewed investor confidence. This evolution reflects a transition from external imbalance to greater macroeconomic stability and a gradual strengthening of the national currency.

The analysis of Morocco's interest rate from 2015 to 2023 reveals a U-shaped trend, mirroring the nominal exchange rate's evolution. Between 2015 and 2020, the steady decline in interest rates reflected an expansionary monetary policy by the Moroccan Central Bank aimed at stimulating economic growth, facilitating credit access, and countering weak economic performance and external shocks. From 2021 onward, the gradual rise in interest rates indicates a policy shift toward normalization, driven by rising inflationary pressures, improved growth prospects, and the need to stabilize the national currency. This upward adjustment also suggests efforts to curb excessive credit demand and attract foreign capital. The overall pattern highlights the Central Bank's adaptive approach, moving from monetary easing during the COVID-19 crisis to cautious tightening as economic conditions improved.

The analysis of Morocco's Gross Domestic Product from 2015 to 2023 shows a steady upward trend, reflecting sustained economic growth throughout the period. GDP increased from 11.41 in 2015 to 11.48 in 2023, indicating a gradual strengthening of national economic activity. This continuous growth can be attributed to structural reforms aimed at diversifying the economy, enhancing competitiveness, and attracting foreign investment.

Key sectors such as agriculture, phosphates, textiles, automotive, and tourism have been major contributors. Public investment in infrastructure roads, ports, and renewable energy also played a crucial role in boosting productivity and reducing logistical costs.

The absence of major downturns highlights Morocco's resilience to external shocks, including commodity price fluctuations and the COVID-19 pandemic. However, while macroeconomic growth remains robust, it does not necessarily guarantee inclusive prosperity. Complementary indicators such as GDP per capita, unemployment, and income inequality are essential to assess the social impact of this growth.

The analysis of Morocco's Consumer Price Index (CPI) from 2015 to 2023 reveals a sharp upward trend, especially after 2020, with inflation accelerating from around 1.4% in 2015 to nearly 6.7% in 2023. Between 2015 and 2019, inflation remained stable and well-controlled, reflecting effective monetary and fiscal management. However, starting in 2020, the CPI rose sharply due to multiple shocks. The COVID-19 pandemic disrupted global supply chains, creating shortages and raising production costs, while expansionary fiscal and monetary policies boosted domestic demand beyond available supply.

From 2021 onward, inflationary pressures persisted, driven by rising global prices of energy and food commodities, and possibly by a depreciation of the Moroccan dirham, which increased import costs. This sustained rise in prices has eroded household purchasing power, raised production costs for firms, and threatened external competitiveness. If unchecked, persistent inflation could force the Central Bank to tighten monetary policy, potentially slowing economic growth.

4.2 Presentation of the Cyclical Components of Macroeconomic Aggregates

This subsection focuses on analyzing the cyclical components of Morocco's key macroeconomic aggregates to identify short-term economic fluctuations around their long-term trends. Unlike trend components, which reveal the structural trajectory of economic variables, cyclical components highlight temporary deviations that reflect phases of expansion and contraction in economic activity. Examining these fluctuations provides valuable insights into Morocco's business cycle dynamics and helps assess the country's short-term economic conditions.

The analysis depicts the cyclical fluctuations of Morocco's nominal exchange rate from 2015 to 2023, after extracting the long-term trend to isolate short-term variations. This analysis highlights temporary or seasonal deviations that are not driven by fundamental economic trends.

Between 2015 and 2018, the cycles exhibit pronounced peaks and troughs, reflecting periods of volatility potentially caused by external shocks, commodity price fluctuations, or domestic policy adjustments. Positive cycles in 2017–2018 likely correspond to temporary currency appreciations due to capital inflows or improved trade balances. From 2019 to 2021, fluctuations moderate, suggesting a relatively stable economic environment.

However, in 2022, the nominal exchange rate shows a sharp increase in volatility, possibly triggered by rising inflationary pressures, external shocks, capital movements, or monetary policy adjustments such as interest rate hikes. By 2023, volatility subsides, indicating a return to relative stability, likely due to corrective policy measures or the dissipation of prior shocks.

The analysis highlights the cyclical fluctuations of Morocco's interest rate from 2015 to 2023, after removing the long-term trend. Cyclical analysis captures short-term variations around the general trend, reflecting temporary factors or specific economic events. Between 2015 and 2019, interest rate cycles were relatively stable, indicating a balanced monetary policy by the Moroccan central bank and a period of economic calm with favorable domestic and external conditions.

From 2019, the cycles declined sharply, reaching a trough in 2020, reflecting an accommodative monetary stance in response to the COVID-19 crisis. The central bank reduced rates to support borrowing, economic activity, and to prevent a prolonged recession, representing significant monetary stimulus.

Starting in 2021, cycles reversed with a rapid increase, peaking in 2022, reflecting the gradual normalization of policy amid economic recovery, rising demand, inflationary pressures, and the need to stabilize the national currency. The peak in 2022 corresponds to rapid interest rate hikes aimed at controlling inflation amid global supply disruptions and rising commodity prices.

By 2023, cycles stabilized at relatively high levels, suggesting a more restrictive monetary policy to counter persistent inflation. Overall, Morocco's central bank shifted from an expansionary stance in 2020 to a more restrictive policy in 2022–2023 to stabilize the economy.

Morocco's GDP cycles from 2015 to 2023 show moderate fluctuations around the long-term trend between 2015 and 2019, indicating stable growth, with slightly positive deviations in 2018–2019 linked to strong sectoral performance. In 2020, GDP cycles plummeted sharply due to the COVID-19 pandemic, reflecting a severe economic contraction. From 2021 onward, cycles rebounded rapidly, signaling recovery and above-trend growth during the post-recession catch-up phase, while 2022–2023 show continued stabilization around the trend.

The cyclical analysis of Morocco's Consumer Price Index (CPI) from 2015 to 2023 highlights short-term fluctuations around long-term trends. Between 2015 and 2019, inflation remained relatively stable, with minor deviations. From 2019, CPI cycles rose sharply, peaking in 2020 during the COVID-19 pandemic due to supply disruptions and demand shocks, followed by a temporary correction. Post-2020, cycles became highly volatile, with a historical peak in 2022 driven by global commodity price increases, external shocks, and expansionary policies, prompting tighter monetary measures. In 2023, CPI cycles fell sharply, indicating a return toward price stability, although short-term sensitivity persists. Smoothed cycles using an HP filter (λ=100) highlight these variations clearly.

The analysis depicts the smoothed cycles of Morocco's real exchange rate from 2015 to 2023, obtained using a Hodrick-Prescott filter with a smoothing parameter of 100 to remove short-term noise and highlight underlying cyclical fluctuations. The real exchange rate reflects the competitiveness of the Moroccan dirham relative to major trading partners by accounting for price level differences.

Between 2015 and 2018, the cycles show a gradual upward trend, indicating a real appreciation of the dirham, likely supported by controlled inflation, improved trade balances, and foreign capital inflows. From 2018 to 2020, a downward phase reflects real depreciation, exacerbated by internal inflationary pressures, trade deficits, capital outflows, and the economic shock of the COVID-19 pandemic. From 2020 onward, the cycles rebound sharply, signaling a recovery in competitiveness, driven by economic reopening, rising exports, stabilized inflation, and renewed investor confidence. In 2022–2023, the real exchange rate reaches new highs, reflecting sustained appreciation, although volatility remains, highlighting the economy's sensitivity to external shocks and the need for careful macroeconomic management.

The smoothed cycles of Morocco's real exchange rate (2015–2023), derived using a Hodrick-Prescott filter with a smoothing parameter of 100, highlight short-term deviations from the long-term trend. From 2015 to 2018, the dirham appreciated due to controlled inflation, improved trade balances, and capital inflows. Between 2018 and 2020, the real exchange rate depreciated, worsened by internal inflation, trade deficits, capital outflows, and the COVID-19 shock. From 2020 onward, a strong rebound reflects recovery in competitiveness, supported by economic reopening, rising exports, and investor confidence, with 2022–2023 showing sustained appreciation. Despite this recovery, volatility persists, indicating sensitivity to external shocks and the need for careful macroeconomic management.

Morocco's interest rate cycles (2015–2023), smoothed with a Hodrick-Prescott filter, reveal periods of policy adjustment in response to economic conditions. From 2015–2018, rates rose gradually to prevent overheating. Between 2019–2021, rates fell sharply during the COVID-19 pandemic to support growth. From 2021–2023, rates increased rapidly to contain inflation and stabilize the economy. The volatility of these cycles reflects the central bank's flexible and proactive monetary policy.

Smoothed GDP cycles in Morocco (2015–2023), derived using a Hodrick-Prescott filter, reveal the economy's short-term fluctuations around its long-term trend. Between 2015–2019, cycles rose steadily, reflecting above-trend economic expansion driven by strong performances in key sectors, infrastructure investments, and economic reforms. In 2020, cycles plunged sharply due to the COVID-19 pandemic, highlighting the severe contraction caused by lockdowns, reduced global demand, and disruptions in tourism, exports, and agriculture. From 2021 onwards, GDP cycles rebounded steadily, indicating post-pandemic recovery and a return to above-trend growth by 2023. The volatility of these cycles underscores Morocco's sensitivity to external shocks, such as commodity price fluctuations, and internal factors, including climate impacts, while also reflecting the economy's resilience.

Smoothed CPI cycles in Morocco (2015–2023), extracted using a Hodrick-Prescott filter, highlight short-term inflation fluctuations around the long-term trend. Between 2015–2017, cycles rose gradually, indicating moderate inflation driven by basic goods prices or seasonal factors, reflecting relative economic stability. From 2017 to 2020, cycles declined, reaching a trough during the COVID-19 pandemic, reflecting reduced domestic demand, lower household spending, and disinflation pressures amid economic contraction. From 2021 onward, CPI cycles surged sharply, reflecting post-pandemic recovery, global supply disruptions, rising commodity prices, and increased production costs. By 2023, cycles peaked at historical highs, signaling strong inflationary pressures that strained household purchasing power and raised business costs, potentially reinforced by inflation expectations and accommodative monetary conditions.

5. Conclusion

The study analyzes Morocco's key macroeconomic aggregates by applying the Hodrick-Prescott filter to decompose them into long-term trends and short-term cyclical components. This approach highlighted both structural and cyclical characteristics of the Moroccan economy and clarified the interactions among variables such as GDP, inflation, interest rates, and the real exchange rate to assess the country's readiness for an IT regime. This methodology allows for a clear understanding of the economy's underlying stability, cyclical dynamics, and responsiveness to shocks.

Structural trends show relatively stable GDP growth between 2015 and 2023, supported by economic reforms, sectoral diversification, and public investment in infrastructure. However, cyclical fluctuations reveal the economy's vulnerability to external shocks, notably the COVID-19 pandemic, which triggered a sharp contraction in 2020. The rapid recovery in 2021 illustrates Morocco's economic resilience, though post-pandemic cycles also contributed to heightened inflationary pressures.

Inflation cycles were relatively stable from 2015 to 2019 but accelerated sharply from 2020 onward, peaking in 2023. This surge reflects external factors, such as rising commodity prices and global supply chain disruptions, combined with increased domestic demand following the economic rebound. Interest rates followed an inverted "U" pattern, reflecting the central bank's policy adjustments: a reduction in 2020 to support economic activity, followed by gradual hikes from 2021 to contain inflation.

The real exchange rate also exhibited significant fluctuations, alternating between appreciation and depreciation phases. The 2015–2018 appreciation reflects stronger export competitiveness, whereas the 2019–2020 depreciation indicates currency weakness, exacerbated by the health crisis. The 2021–2023 rebound points to improved external competitiveness, although the continued volatility highlights Morocco's sensitivity to capital flows and external shocks.

All in all, the results highlight periods of stable growth, controlled inflation, and identifiable economic cycles, which are essential conditions for implementing a credible IT policy. By linking the behavior of key aggregates to the prerequisites for inflation targeting, the paper demonstrates the importance of stable growth, moderate inflation, and predictable economic cycles in supporting the feasibility and effectiveness of a forward-looking monetary policy in Morocco.

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