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Identification of fluctuations origins in the Business Cycle in Morocco: Reduced DSGE modelling

Identification des origines de fluctuations du Business Cycle au Maroc : modélisation DSGE réduit.

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Résumé

Cet article explore les origines des fluctuations cycliques au Maroc en utilisant un modèle d'équilibre général stochastique dynamique (DSGE) réduit privilégiant l'examen des chocs résultant des variations de la demande, de l'offre, ainsi que de la politique monétaire. Pour étayer notre étude, nous mobilisons des données s'étalant du premier trimestre 2007 au quatrième trimestre 2022. Les résultats obtenus soulignent le rôle prépondérant des perturbations du côté de l'offre dans les variations de la production et de l'inflation au Maroc L'économie réagit de manière plus marquée aux facteurs liés l'offre, notamment la productivité, les interruptions de la chaîne d'approvisionnement et la dynamique de l'offre agricole. Les implications de ces constatations sont d'importance pour les décideurs politiques, mettant en évidence la nécessité d'ajuster et d'adapter leur politique en vue de stabiliser l'économie et de promouvoir la croissance économique.

Mots clés : Cycle économique, DSGE réduit, Origines de fluctuations, Chocs d'offre.

Abstract

This article explores the origins of cyclical macroeconomic fluctuations in Morocco. A reduced Dynamic Stochastic General Equilibrium (DSGE) model is used to identify these fluctuations, with a specific focus on demand, supply and monetary policy shocks. The study leverages data spanning from the first quarter of 2007 to the fourth quarter of 2022.The results indicates that supply pertubations predominantly drive production and inflation fluctuations within Morocco. Our economy tends to react more sensitively to supply-side factors, such as productivity fluctuations, supply chain interruptions and agricultural supply dynamics. The implications of these findings are significant for policy-makers, revealing the necessity to adjust and adapt their policies in order to stabilise the economy and promote economic growth.

Keywords : Business cycle, Reduced DSGE, Fluctuations origins, Supply shocks.

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Introduction

The study of cyclical macroeconomic fluctuations is fundamental for evaluation, assessment and execution of economic policies. The establishment of monetary or fiscal measures in the economy is closely linked to the short-term variability of key macroeconomic aggregates. The choice between implementing a restrictive or expansionary policies depends on the economy's position in the business cycle. The focus should probably be on stimulus measures such as reducing the monetary policy rate or increasing public spending when economic activity is in a slowdown phase, as in the case of the emergence of the COVID-19 pandemic. Conversely, in a robust economic situation due to a post-crisis expansion, considerations may tend to favour austerity measures such as tightening monetary policy or implementing fiscal restraint. These measures are aimed at preventing the overheating, controlling inflationary pressures and maintaining overall economic stability. The appropriate policy stance depends on the specific circumstances and challenges facing the economy at any given point in the economic cycle. Implementing these policies requires a thorough understanding of the cyclical fluctuations in the main macroeconomic indicators.

In this vein, the overarching question guiding this study is: **What drives the business cycle in Morocco ?** To address this, we propose an investigation into the sources of cyclical fluctuations in Morocco, adopting a contemporary perspective on the cyclical concept. In our study, the cycle is defined, according to Lucas (1977), as production deviation from its long-term trend, with stochastic characteristics. Our chosen methodology employs a Dynamic Stochastic General Equilibrium (DSGE) model, reflecting a commitment to a meticulous exploration of cyclical dynamics in the Moroccan economy.

Our reasearch is motivated by a lack of empirical studies focusing on the business cycle in developping countries, particulary Morroco. To fill this gap, in contrast to existing studies, we opt for a macroeconomic modeling approach that examines the behavior of economic agents in a closed economy. This approach considers uncertainty and random shocks, aiming to answer our primary research inquiry. This analytical framework is based on a New Keynesian perspective.

Consequently, a positivist epistemological posture and a quantitative hypothetico-deductive approach would be compatible with our research objective. From a structural approach, in order to answer the previously mentioned question, we have followed a logical pattern of invistigation in three sections. The first section provides a synthesis of the theoretical and empirical literature review relative to our research question. The second section is dedicated to the presentation of data and the model. Finally, the main results of our estimation are discussed in the last section.

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1. Literature review

Although the literature on the sources of cyclical fluctuations is quite abundant, there does not seem to be a clear consensus. There is no near-unanimity on the nature of the sources of economic cycle fluctuations. Studies on economic fluctuations in developing countries have not been very conclusive. Generally, the literature highlights a "domestic-external" dichotomy when determining and identifying the sources of cyclical fluctuations. In fact, one stream of literature attributes the recurrent economic fluctuations in developing countries to external perturbations (Mendoza, 1995; Kose and Riezman, 1999; Ahmed, 2003). However, other studies emphasize that internal shocks are largely responsible for fluctuations in production in developing countries (Hoffmaister and Roldós, 2001a; Raddatz, 2007). Understanding the sources of macroeconomic fluctuations and their consequences for the economy is crucial for policymakers to formulate appropriate policies to mitigate the effects of shocks on their economies. Some studies consider that the external shocks can only explain a modest share of the variance in production in developing economies (Hoffmaister & Roldós, 2001a; Sissoko & Dibooglu, 2006; Raddatz, 2007; Bastos & Divino, 2009). In fact, several authors have examined the contribution of domestic shocks to the dynamics of developing economies. Quijada (2007) concludes that cyclical fluctuations in activity arise, in the neo-Keynesian context, from aggregate supply or demand shocks. Advocating convincingly for a demand source, Andrle, Bruha and Solmaz (2017) mention that most economic cycle fluctuations are due to inflation. Similarly, several studies demonstrate that investment-specific technology shocks constitute a source of these fluctuations (Blanchard & Quah, 1989; Fisher, 2006; Smets et al., 2007; Justiniano, Primiceri & Tambalotti, 2010). Likewise, many authors have tried to identify monetary policy as a source of cyclical fluctuations. Monetary policy shocks are the main sources of macroeconomic volatility (Clarida, Gali and Gertler, 2000; Lubik & Schorfheide, 2004; Stock et al., 2004; Gambetti, Pappa & Canova, 2005; Sims & Zha, 2006; Bianchi, 2013). This category of shock, according to Rossi & Zubairy (2011), is relatively more important for explaining economic cycle fluctuations. In this regard, Kanczuk (2004) showed that production fluctuations are quite responsive to real interest rate shocks. Rasaki & Malikane (2015) argue that money supply shocks are the most dominant. Othmani (2018) states that monetary policy, in addition to supply shocks, affects the business cycle. Empirical literature on identifying the sources of cyclical fluctuations reveals that techniques used generally focus on two distinct categories: modeling and statistical analysis. The first category relies on modeling that takes into account key macroeconomic aggregates such as economic growth, investment and consumption. This approach is based on reduced-form econometric models such as structural

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vector autoregression (SVAR), vector autoregression (VAR), or semi-structural vector autoregression (Semi-SVAR), as well as structural models, like a dynamic stochastic general equilibrium (DSGE) models which regarding econometric models, they have the privilege of being both simple and rich in insights.

In this context, Genberg (2003) estimates a semi-structural VAR using macroeconomic aggregates from Hong Kong, both domestic and foreign, on a quarterly basis covering the period from 1984Q1 to 2002Q2. Similarly, Hoffmaister and Roldós (2001b) determine the sources of fluctuations in Brazil and Korea, distinguishing between domestic and foreign variables, by analyzing the variance decomposition after estimating SVAR. In contrast, Rossi and Zubairy (2011) identify the sources of macroeconomic fluctuations using a counterfactual analysis, in which they assume that the economy is influenced by one shock individually, following the estimation of a VAR with domestic variables related to the U.S. economy. As for structural models, they provide a more comprehensive representation of the economy and respond by their nature to Lucas's criticism. Liu, Waggoner and Zha (2011) examine the sources of macroeconomic fluctuations by estimating a highly parameterized DSGE model in a unified framework that incorporates regime changes in both shock variances and inflation targets. In Morocco, studies that focus on identifying the sources of cyclical fluctuations using structural modeling are quite rare. We find that Bennouna et al (2016), to analyze the response of key macroeconomic aggregates to interest rate variations, estimate an NKM based on quarterly data covering the period from 1998Q1 to 2014Q4, in order to compare its results with those of an SVAR estimation. Othmani (2018) opts for the estimation of a hybrid New Keynesian model (HNKM) consisting of three structural equations characterizing the Moroccan economy and a BVAR-DSGE using quarterly data from 1998Q1 to 2016Q4.The second technique involves various statistical methods. Andrle et al (2017), using statistics introduced by Stock and Watson (2002), show that there is a strong and predictable co-movement of real variables during the economic cycle in a panel of advanced economies. Elguellab & Ezzahid (2021), by calculating the cross-correlations of the cycles of interest and reference variables while taking into account the duality characterizing the Moroccan economy, conclude that agricultural shocks as a supply shcoks are the most dominant.

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2. Model and data

2.1. Model presentation

We will use a model within the New Keynesian framework of macroeconometric modeling. Thus, a reduced DSGE model tracing the different relationships in the economy among three agents, namely households, firms and the central bank, will be estimated. The model is based on the work of Woodford (2003) and Clarida et al. (2000), where the first two agents are considered optimizers, while the monetary authority is described by the Taylor rule. Our model will include three key equations: the first representing the IS curve expresses the output gap as a function of its past and expected values and the interest rate minus expected inflation, the second corresponding to the New Keynesian Phillips Curve (NKPC) relates current inflation to past and expected inflation and the output gap and the last one representing a dynamic version of the Taylor rule reflecting the central bank's response to inflation and the output gap.

$$y_t=(1-\psi)y_{t-1}+\psi\, Et(y_{t+1})-\varphi(R_t-E_t(\pi_{t+1}))+\eta_t^y \quad (1)$$

$$\pi_t=(1-\omega)\pi_{t-1}+\omega E_t(\pi_{t+1})+\kappa y_t+\eta_t^\pi \quad (2)$$

$$R_t=\xi_r R_{t-1}+\xi_y y_{t-1}+\xi_\pi \pi_{t-1}+\eta_t^R \quad (3)$$

$$\eta_t^y=\rho_{\eta y}\eta_{t-1}^y+\sigma_{\eta t}^y \quad (4)$$

$$\eta_t^\pi=\rho_{\eta\pi}\eta_{t-1}^\pi+\sigma_{\eta t}^\pi \quad (5)$$

$$\eta_t^R=\rho_{\eta R}\eta_{t-1}^R+\sigma_{\eta t}^R \quad (6)$$

Where y_t is the output gap, R_t is the interest rate or the policy rate, π_t is inflation and η_t^y , η_t^π , η_t^R are demand, supply and monetary policy shocks, respectively which are defined as first-order autoressgressif proccess (equations 4, 5 & 6).

The use of this type of modelling is justified by its robustness in the face of the fundamental criticisms of Lucas and Sims, who respectively raised problems of temporal consistency and identification in traditional macroeconomic models. Lucas' critique emphasised the need for economic agents to correctly anticipate changes over time, calling into question models based on adaptive expectations. At the same time, Sims revealed the difficulties arising from the use of simultaneous equations without explicitly specifying the structural relationships between the variables. Therefore, modelling inspired by the New Keynesian approach provides a rigorous framework for analysing and identifying the sources of economic fluctuations, on the basis of which the impact of different economic policies could be explored.

In order to simulate our model, it is essential to calibrate the associated parameters in accordance with the guidance provided by the DSGE model literature (e.g., Smets et al. (2007)). The parameters are calibrated and their values are presented in Table 1.

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Table N°1 : Parameter values used for model calibration

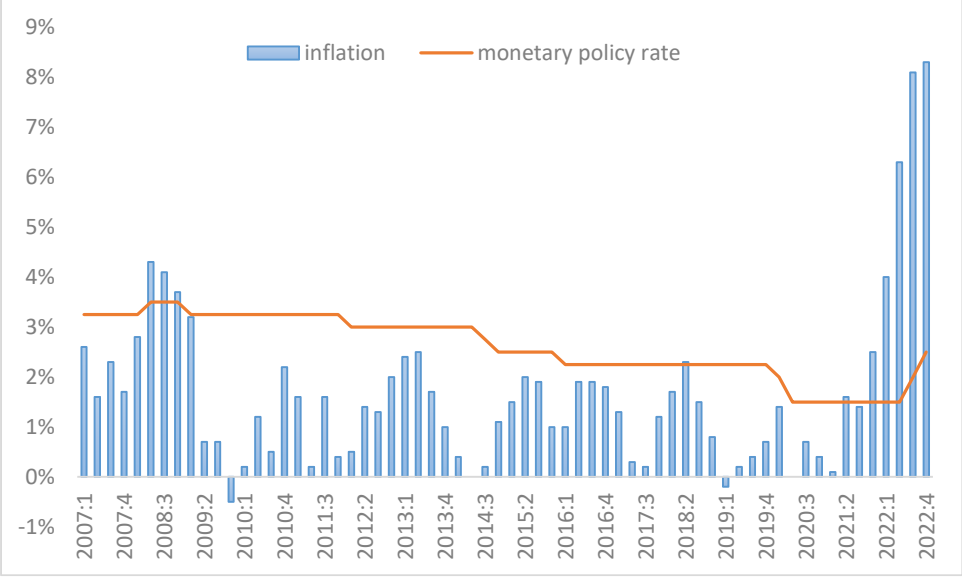
Parameters	Designation	value
ψ	The degree of sensitivity of the output gap to its anticipated level	0,49
φ	The inverse of the intertemporal consumption substitution elasticity	0,03
ω	The sensitivity of current inflation to its anticipated level	0,5
κ	The sensitivity of inflation to fluctuations in production	0,08
ξ_r	The response of the interest rate to the lagged one	0,99
ξ_y	The response of the interest rate to the output gap	0,7
ξ_π	The response of the interest rate to deviations in inflation	0,047

Source : Authors

2.2. Data presentation

The data used include the policy rate, inflation rate and output gap or production gap. The policy rate is obtained from the Bank Al-Maghrib, the output gap is calculated after estimating potential production using the Hodrick-Prescott (HP) filter and the inflation rate is calculated from the consumer price index published by the High Commission for Planning. Note that all data are quarterly and cover the period from 2007Q1 to 2022Q4, resulting in 64 observations.

Figure N°1 : Inflation and Policy rate evolution in Morocco between 2007Q1-2022Q4



Source : Authors, based on data from High Commission for Planning and Bank Al Maghrib

Inflation in Morocco, measured by the year-on-year change of the consumer price index, is considered a key variable for the economy. It's also closely monitored by the Moroccan authorities, especially the Central Bank (Bank Al-Maghrib). The central bank's main objective is to keep inflation rates around 2%.

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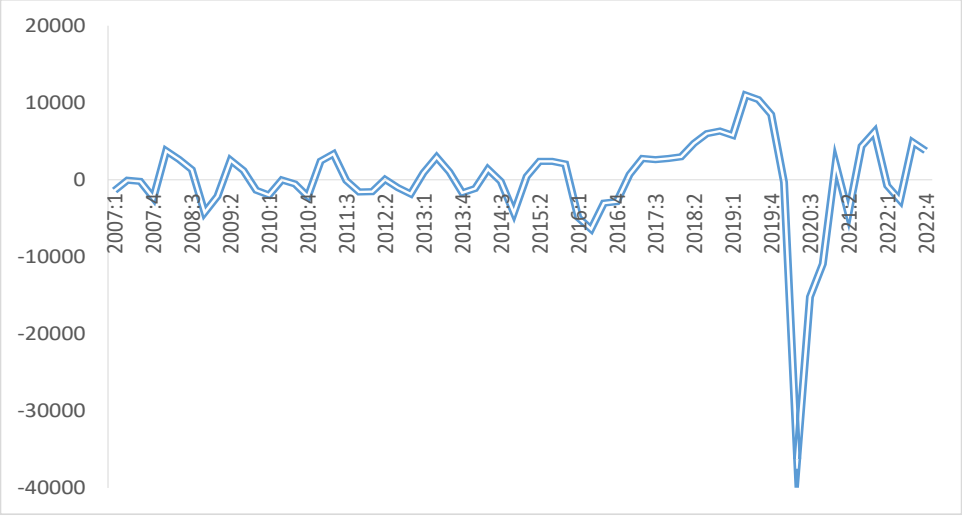
In our study period, the inflation rate fluctuates between -0,5% recorded in the fourth quarter of 2009 and 8,3% in the last quarter of 2022 (Figure 1). However, it should be noted that this aggregate is generally stable, except when the global economy has been exposed to the effects of the financial crisis, the heath crisis and geopolitical conflicts. In 2008, the inflation rate averaged +3,8%, after recording +2,1% a year earlier. Between 2009 and 2021, inflation had decelerated to around +1%, before accelerating to +6,7% in 2022 due to Russo Ukranian war and China's zero covid policy. Several factors have contributed to these different evolutions, including fluctuations in international commodity prices, weather conditions and supply chain shocks. The policy rate, as an instrument of monetary policy defined by Bank Al-Maghrib, to maintain an equilibrium between economic growth and price stability, is subject to changes according to the objectives of that policy, in particular keeping inflation under control and stimulating economic growth. In general, the policy rate is reduced to promote economic activity during periods of decline, as was the case in health crisis when the Moroccan economy was in recession, and increased to control inflation, as was the case in 2008 and is currently the case. Since the policy rate has risen from +3,25% to +3,5% in the second quarter of 2008, before settling into a decreasing trend and losing 2 percentage points from the last quarter of 2008 to the second quarter of 2022. At the end of 2022, the inflation rate had reached 2,5% (Figure 1).

Figure N°2 : Moroccan Business Cycle 2007Q1-2022Q4



Source : Calculated and elaborated by the authors based on data from the High Commisssion for Planning

The Moroccan economy has experienced several periods of recession and recovery between Q1 2007 and Q4 2022. Morocco's output gap also illustrates the main crashes (2008 and 2020), reflecting the significant economic contractions and subsequent recoveries that characterised

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the period of our study(Figure2). In 2008, the crisis was the result of failures in the financial sector, which was underdeveloped in Morocco, as in other countries. Our economy was less affected than that of the United States, for example. By contrast, the crisis of 2020, launched by the COVID-19 pandemic, caused widespread perturbations in the real economy as a result of lockdown measures, and had an immediate and more severe impact on economic activity.

1. Results discussion

It is important to highlight that the model simulation was carried out utilizing Dynare 5.4 software within the Matlab R2021a as an environment. In order to discern the origins of cyclical fluctuations in Morocco, we have to examine a variance decomposition analysis. This method serves as a valuable tool in addressing our fundamental question: what are the driving forces behind the Moroccan business cycle? The variance decomposition offers an analytical framework to quantify the influence of each economic shock on the variability of individual variables.The outcomes presented in Table 2 shed light on the reactions of our model's variables to a range of economic shocks, specifically those related to demand, supply and monetary policy. In essence, these findings provide insights into the proportional contributions of each shock to the expected fluctuations in each variable.

Table N°2 : Variance Decomposition (in %)

	Demand Shock	Supply Shock	Monetary Shock
Production	31,75	66,89	1,36
Inflation	2,67	94 ,78	2,55
Policy rate	48,52	50,10	1,38

Source: Authors, based on simulation results generated by Matlab R2021b.

The analysis of variance decomposition of error terms in our study offers a nuanced understanding of the various driving forces behind economic fluctuations in Morocco. Notably, it reveals that the majority portion of the variance in production could be primarily attributed to supply shocks (66,89%). This signifies that shifts in the supply of goods and services, influenced by factors like productivity and agricultural performance, play a dominant role in influencing the fluctuations in production levels. Furthermore, the magnitude of the impact of supply shocks on production, as demonstrated in Table 2, is notably more substantial in comparison to other shocks. Remarkably, the results indicate that changes in the policy rate have no appreciable effect on the level of production (1,36%). This observation has implications for policymakers, suggesting that, at least within the studied timeframe and context, monetary policy adjustments do not significantly impact the overall level of economic output. Instead, the Moroccan economy seems to be particularly sensitive to supply fluctuations, highlighting

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the importance of addressing structural issues and ensuring the stability of the production process to foster economic growth and resilience.

Shifting our focus to the realm of inflation, we find a similar trend. A large part of inflation's volatility is closely associated with supply shocks (94,78%). It appears that Morocco's inflation trends are notably influenced by supply-side shocks, which, in turn, play a pivotal role in determining the trajectory of the policy interest rate.

Regarding monetary policy, the demand and supply shocks have a similar and relatively substantial influence on the fluctuations in the policy rate (48,52%, 50,10% respectively). This means that changes in the demand for goods and services, as well as supply-side factors like productivity, could lead to adjustments in the central bank's policy rate. On the other hand, a direct shock to the policy rate itself, such as a deliberate interest rate adjustment by the central bank, appears to have a relatively limited impact on the overall dynamics of the economy. This suggests that in this particular economic context, changes in the policy rate imposed by the central bank may not be the primary driver of economic fluctuations and other factors, especially demand and supply dynamics, play a more significant role in influencing the policy rate and its effects on the economy.

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Conclusion

In conclusion, this article examines the factors contributing to cyclical fluctuations within the Moroccan economy through the utilization of a reduced DSGE model. The study employs a rigorous methodology to ascertain and scrutinize the impact of demand, supply and monetary policy shocks on pivotal macroeconomic variables, notably output, inflation and the policy rate.The findings prominently underscore the pivotal role of supply shocks in explaining fluctuations in output and inflation within Morocco, attributing a substantial majority of the variance in these variables to such shocks. In contrast, demand and monetary policy shocks exhibit comparatively modest effects. Therfore, Moroccan economy demonstrates a heightened responsiveness to shifts in supply conditions, including changes in productivity or agriculture performance, in contrast to alterations in demand or interest rate fluctuations.These results have considerable implications for policy-makers, as they underline the crucial importance of understanding the origins of economic fluctuations once economic policies have been formulated, in order to ensure that they are effective.. Policymakers are urged to recognize that factors associated with the supply side, including alterations in production capacity and productivity, exert a substantial influence on the Moroccan economy. Hence, crafting policies aimed at enhancing supply-side resilience and addressing structural concerns emerges as particularly vital for fostering economic stability and facilitating sustainable growth.

Overall, this research offers a valuable addition to the existing empirical literature on the sources of business cycle fluctuations in developing economies, particularly in Morocco. It provides precious insights about the relative importance of the different shock. Consequently, it becomes pertinent to consider, in light of these findings, how extant stabilization policies can be adapted to more effectively address the challenges posed by the Moroccan economy's susceptibility to supply shocks.

Moreover, it is judicious to explore additional research directions aimed at gaining deeper insights into the underlying mechanisms governing these fluctuations. In this specific context, the development of more effective and robust economic policies takes on utmost importance and merits the consideration of both researchers and economic policymakers.

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