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Modelling The Relationship between Cyclical Output and Cyclical Unemployment: Empirical Validation of Okun's Law - The Case of Morocco.

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ABSTRACT: The aim of this study is to analyse the dynamic relationship between economic growth and unemployment in Morocco. By examining the validity and asymmetry of Okun's law. Based on quarterly data covering the period from 2000 to 2022, we adopt a dynamic modelling of Okun's law, with the aim of estimating its elasticities during recessions and expansions using an ARDL model. The results of the study show the existence of an inverse relationship between GDP and unemployment with a strong persistence of the unemployment rate. The asymmetry study showed that unemployment reacts more strongly to negative deviations in real GDP than to positive deviations.
In terms of policy implications, the study recommends the need to reform the structure of the Moroccan economy so as to allow the integration of a greater number of workers, while stimulating economic growth through the promotion of labour-intensive investment. Involving the Moroccan economy in a process of structural transformation is a crucial element, and investment in areas such as innovation, R&D or digital technology can help to increase real gross domestic product and consequently reduce the unemployment rate.

KEYWORDS: Economic growth, Unemployment, Okun's Law, ARDL.

INTRODUCTION

The underlying correlation between economic output and unemployment is a long-standing issue in economic literature. GDP is the end result of an economy's activity, while the unemployment rate is considered to be one of the main indicators of economic performance, determining the well-being of the population. Indeed, the debates on economic growth and unemployment have now taken on a central role in countries' development strategies. The interaction between these two factors is central to the definition of economic policies. In the short term, the dynamics between economic growth and unemployment are relatively well understood, i.e. within economic cycles, but in the long term this understanding is less clear-cut, i.e. at structural level.

Unemployment is still the most serious threat to a country's development process. It is often suggested that boosting economic growth is an appropriate response to high unemployment. However, increasing the growth rate does not automatically guarantee a fall in the unemployment rate, for several reasons. Firstly, the working population may be growing at a faster rate than jobs are being created. In addition, economic growth may have a low employment potential due to the increase in productivity. (Huang & Lin, S., 2008).

In 1962, **Arthur Okun** established a negative correlation between economic growth in GDP and the unemployment rate in the United States during the 1950s. In fact, **Okun** demonstrated that a 1% increase in real GDP in the US led to a 0.4% reduction in the unemployment rate. What's more, when a growth rate reaches 3%, the unemployment rate tends to stabilise. Above 3%, the jobs created contribute to a reduction in the unemployment rate (Sboui., Nouira, & Gouider, 2018).

Like most developing countries, the Moroccan economy is characterised by persistent unemployment and a low contribution of economic growth to job creation. The Moroccan labour market is characterised by three challenges that can be cited as follows (HCP & Banque Mondiale, Novembre 2017) : firstly, slow employment growth, i.e. the number of jobs created is not sufficient to absorb the influx of the working-age population. Secondly, the lack of inclusion, meaning that young people and women are less integrated into the labour market than the rest of the active population. Thirdly, low-quality jobs, which shows that the Moroccan labour market is dominated by informal work.

Analysing the correlation between economic growth and unemployment is particularly important in the Moroccan context. Despite the economic reforms undertaken and the substantial investment in education and vocational training, Morocco generally has a double-digit unemployment rate. Moreover, unemployment in Morocco is mainly structural in nature, as shown by the

significant increase in the number of long-term unemployed (over one year). As a result, the economic growth seen in recent decades has failed to create enough jobs to absorb new entrants to the labour market, particularly women and young graduates. The main objective of this study is to assess the responsiveness of the unemployment rate to fluctuations in the GDP growth rate in Morocco, which involves estimating the Okun coefficient, checking its validity and testing the asymmetry of this relationship.

I. REVIEW OF LITERATURE

Practical economic policies aim to boost economic growth and reduce unemployment. The discussion about the relationship between GDP growth and unemployment remains a hot topic. In 1962, **Arthur Okun** was the first to formally express the intuition of a negative correlation between economic growth and unemployment. Okun's law states that: "every time GDP falls by a certain percentage, relative to potential output, the unemployment rate rises by about one percentage point. Thus, when real GDP falls, the unemployment rate rises" (Mankiw, 2003). It measures the elasticity of the unemployment rate to variations in real GDP growth. In an empirical approach, using data on the US economy, **Okun** showed that a 1% fall in real GDP leads to a 0.3 percentage point increase in the unemployment rate (Okun A. , 1962). **Okun** 's law therefore measures the elasticity of the unemployment rate to variations in real GDP growth.

To analyse this relationship, (Okun A. , 1962) studied two equations, the gap version and the difference version (Mandri, El Abbassi, I., & Moussir, C. E., 2018).

1- Gap approach :

The gap approach, on the other hand, reports the deviations of the two variables from their respective trend levels. These deviations thus represent the cyclical components of unemployment and real GDP. The gap model is written as follows:

$$u - u^* = c + \beta(Pib - Pib^*) + \varepsilon \qquad (1)$$

With u^* is the natural rate of unemployment, Pib^* the potential GDP and the difference $Pib - Pib^*$ represents the Output Gap. β is the Okun coefficient, it measures how much the cyclical unemployment rate changes when the Output Gap changes by 1%. This model analyses the relationship between the unemployment gap and the output gap in relation to their potential levels, assuming that a high unemployment rate results from under-utilised resources, i.e. when output is below its potential level, signalling an under-utilisation of resources. On the other hand, when actual output approaches potential output, available resources are better utilised and the unemployment rate falls.

However, (Knotek, 2007) points out that the main difficulty with the "gap" approach lies in determining the natural rate of unemployment and potential GDP, since they are not directly observable. Various methods have been used to measure these variables, such as the Hodrick-Prescott filter (Moosa I. , 2008), the Baxter-King filter (Freeman, 2001) & (C. & Chang Y.K., 2005), the Beveridge-Nelson filter and the Kalman filter (Moosa I. , 1997).

2- Difference approach :

In the second approach, known as the "first differences" approach, fluctuations in the unemployment rate are linked to real GDP growth rates. The model can be presented as follows:

$$\Delta u = c + \beta \Delta Pib + \varepsilon \qquad (2)$$

With Δ represents the first difference of the variable; u is the unemployment rate; Pib is the logarithm of real GDP. The coefficient β quantifies the magnitude of the change in the unemployment rate in percentage points when real GDP varies by 1% (Sboui., Nouira, & Gouider, 2018).

In this approach the link between the unemployment rate and GDP growth rate is based on the idea that an increase in economic growth leads to an expansion of employment, which decreases the unemployment rate, assuming that the labour force grows at a constant rate.

Several economists followed (Okun A. , 1962), testing the link between the unemployment rate and the variation in output to verify the validity of the negative correlation between the growth rate and the unemployment rate explained by **Okun**. A large number of studies examine this relationship in a linear framework and assume that cyclical increases and decreases in output have symmetric effects on unemployment (Gordon, 1984), (Hamanda & Kurosaka, Y., 1984), (Prachowny, 1993), (Moosa I. A., 1999), (Moosa I. , 1997), (Silvapulle, Moosa, I. A. , & Silvapulle, M. J., 2004), (Christopoulos, 2004), (Gabrisch & Buscher , H., 2006), (Moosa I. , 2008), (Ahmed, H. & Awadalbari, A., 2014). These studies generally provide estimates of the Okun coefficient, its estimates change from country to country and evolve over time. Empirical estimates of the Okun coefficient are influenced by the specification of the model. When the validity and stability of Okun's law were questioned and debated by

(Sögner & Stiassny, A., 2002) and (Perman & Tavera, C., 2005), there was little evidence that the labour market should respond to the business cycle in a symmetric way. In response to this issue, researchers have turned their interest to non-linear modelling of the relationship between unemployment and output (Lee, 2000), (Harris & Silverstone, B., 2001), (Sögner & Stiassny, A., 2002), (Vougas, 2003), (Silvapulle, Moosa, I. A. , & Silvapulle, M. J., 2004), (C. & Chang Y.K., 2005), (Huang & Lin, 2006), (Fouquau, 2008), (Beaton, 2010), (Jardin, 2010), (Shin, Yu, & Greenwood-Nimmo, 2014), and (Sboui., Nouira, & Gouider, 2018), etc.

The empirical studies on the validity and stability of Okun's law for Morocco are discussed here. We first refer to the work of (Moosa I. , 2008), which evaluated the Okun coefficient for the period 1990-2005 for Algeria, Egypt, Morocco and Tunisia. Their results show that Okun's law is not valid in the countries studied over the period in question. For Morocco, the estimated coefficient was 0.102. In another paper, (Ezzahid & El Alaoui, 2014) using annual data from the HCP over the period 1999-2016, found a significant coefficient of -0.14. (Mandri, El Abbassi, I., & Moussir, C. E., 2018) estimated the two equations of Okun's relation for the Moroccan economy, using annual data from the HCP over the period 1999-2016. They found significant coefficients of -0.147 and -0.151 for both versions. Disaggregating GDP into demand components, they found that gross capital formation and exports had a significant effect on changes in unemployment, with coefficients of around -0.052 and -0.045 respectively. According to them, a 1% increase in imports leads to a 0.066% increase in the unemployment rate, while final consumption has no significant impact. Also using HCP data, (Soudi & Ziroili, M., anvier - Février 2018.) found a similar Okun coefficient (-0.15). Their analysis also disaggregated the unemployment rate by gender, age group, background and qualification level. The results showed that the category most sensitive to economic conditions was that of higher education graduates, with a coefficient of -0.75. The coefficients relating to unemployment among women, young people under the age of 30, rural areas and non-graduates were not significant over the period studied. (El Faiz. & Tounsi., March, 2019), in their work have analysed the cyclical fluctuations of output and unemployment in Morocco using a sectoral approach of Okun's law. They tested the validity of Okun's law under different specifications for Morocco over the period 2000-2014. The results revealed the existence of a structural break in the Okun relationship in Morocco, as well as strong unemployment rigidity. For the static model, the results showed a significant inverse relationship with an Okun coefficient of -0.087 over the period studied. On the other hand, the results of the dynamic specification model showed that cyclical unemployment depended only on its lagged values for the study period.

II. METHODOLOGY :

To empirically assess the relationship between cyclical GDP and the cyclical unemployment rate, we will use quarterly data for the Moroccan economy covering the period 2000 to 2022. These data come mainly from the Haut-Commissariat au Plan website[1].

Model specification:

We propose a model that adopts the linear approach associating the deviations of the two variables from their respective trend levels, known as the "gap model".

To estimate Okun's law according to the gap approach, we use the model of (Weber, 1995)[2]:

$$u_t^c = \beta y_t^c + \varepsilon_t \qquad (1)$$

With :

$$u_t^c = u_t - u_t^*$$

And :

$$y_t^c = y_t - y_t^*$$

u_t : is the unemployment rate, y_t : is the log of GDP, β is the Okun coefficient and ε_t is an error term. u_t^* indicates the natural rate of unemployment, y_t^* is the potential GDP also known as the trend level of output. They are generally measured using a filter. With reference to (Sboui., Nouira, & Gouider, 2018), we propse the Hodrick-Prescott filter. The disparity between the observed variables and the trend, representing the potential, corresponds to the cyclical component (u_t^c et y_t^c).

The Hodrick-Prescott filter is used to study time series. The HP filter is used to separate business cycles (short-term fluctuations or trends) from long-term trends. The method tolerates slow deviations from trend, by imposing that this deviation from the trend

[1] GDP data are presented in volume terms.

[2] (Silvapulle, 2004)

does not exced a certain value representing developments in the business cycle. According to the HP filter, a time series x_t is the sum of a cyclical component y_t and a trend τ_t :

$$x_t = \tau_t + y_t \qquad \text{for any } t = 1,...,T$$

In general, this filter is used to obtain a smoothed curve of a sequence of raw data over a given period, which reacts more to long-term fluctuations than to short-term fluctuations. The sensitivity of the trend to short-term variations is modified by changing the multiplier λ. The optimisation programme for determining the trend is as follows (Hodrick, 1997.):

$$\min_{\tau}\left(\sum_{i=1}^{n}(y_t-\tau_t)^2+\lambda\sum_{i=2}^{T-1}\left[(\tau_t-\tau_{t-1})-(\tau_{t-1}-\tau_{t-2})\right]^2\right)$$

With, $\tau_t = x_t - y_t$ and λ is a positive coefficient which reduces the variability of the trend.

In order to take account of the dynamic nature of the Okun relationship, we adopt a specification according to (Silvapulle, Moosa, I. A. , & Silvapulle, M. J., 2004), which proposes equation (2) representing the distributed delay version of the gap approach in equation (1):

$$u_t^c = \sum_{j=1}^{p}\alpha_i u_{t-i}^c + \sum_{j=1}^{q}\beta_i y_{t-i}^c + \varepsilon_t \qquad \textbf{(2)}$$

For this model, the following formula is used to calculate the average impact of GDP on unemployment:

$$\sigma = \frac{\sum_{j=1}^{q}\beta_i}{1-\sum_{j=1}^{p}\alpha_i}$$

In our work, we evaluate the asymmetry of Okun's law by following the estimation of (Lee, 2000):

$$u_t^c = -(\beta^+ I^+ y_t^c + \beta^- I^- y_t^c) + \varepsilon_t \qquad \textbf{(3)}$$

I is an indicator function such that :

$$I^+ = \begin{cases} 0 & si\ \ y_t^c < 0 \\ 1 & si\ \ y_t^c \geq 0 \end{cases}$$

And:

$$I^- = \begin{cases} 0 & si\ \ y_t^c \geq 0 \\ 1 & si\ \ y_t^c < 0 \end{cases}$$

Equation (3) can then be expressed in the following dynamic form:

$$u_t^c = \sum_{p=1}^{P}\alpha_t u_{t-i}^c + \sum_{q=0}^{Q}\beta_i^+ I^+ y_{t-i}^c + \sum_{q'=0}^{Q'}\beta_i^- I^- y_{t-i}^c + \varepsilon_t \qquad \textbf{(4)}$$

The medium-term impact of output on unemployment can be broken down into periods of both expansion σ^+ and contraction σ^- in the cycle:

$$\sigma^+ = \left\{\sum_{q=0}^{Q}\beta_i^+ \,/\, 1-\sum_{p=1}^{P}\alpha_i\right\}$$

$$\sigma^- = \left\{\sum_{q'=0}^{Q'}\beta_i^- \,/\, 1-\sum_{p=1}^{P}\alpha_i\right\}$$

According to (Silvapulle, Moosa, I. A. , & Silvapulle, M. J., 2004), σ^+ and σ^- must be negative. Again, if si $\beta_i^+ = \beta_i^-$ for

each lag i, the asymmetry hypothesis is rejected, then equation (4) can be simplified into a symmetric model (2) and therefore $\sigma^{+} = \sigma^{-} = \sigma$.

III. ESTIMATION RESULTS :

1. ***Static model (equation 1):*** The scatterplot shows the existence of a negative correlation between cyclical GDP and cyclical unemployment. The results obtained by the model corroborate those of the literature, highlighting the existence of an inverse and significant relationship over the period 2000Q1-2022Q4 with an Okun coefficient of -1.267. The model is significant overall, with the Fisher statistic having a probability equal to zero (Probability F = 0.000087). The adjusted coefficient of determination associated with this model is 14.87%. This means that cyclical unemployment is explained to the extent of 14.87% by cyclical GDP and since the regression includes only one independent variable, this coefficient remains acceptable. To evaluate this regression, we applied several tests.
2. ***Dynamic model (equation 2):*** The specification of the lag number is performed by selecting the model that minimises the Akaike Information Criterion (AIC). The selection results suggest an ARDL (1,0) model. Estimation of this long-term relationship shows that the Okun coefficient is negative and insignificant. This result means that the increase in output can lead to a reduction in the unemployment rate. These estimates show that cyclical unemployment depends only on its lagged values for the period studied. Generally, this behaviour can be explained by the presence of unemployment hysteresis effects.
3. ***Asymmetry test (equation 4):*** According to the result of the estimation, it is possible to conclude that the estimated long-run coefficient (the Okun coefficient) is negative when the economy is operating in a period of expansion (with a positive deviation), on the other hand, it is positive for the case in a recession regime (with a negative deviation). More precisely, this coefficient weakens, in absolute terms, during expansion phases compared to recession phases. According to the estimates of the asymmetric model, cyclical unemployment is more sensitive to negative than positive real GDP gaps. During a recession, if the real GDP growth rate falls by 1%, unemployment rises by 2.64%. On the other hand, during an expansion, GDP growth of 1% reduces unemployment by 2.31%.

CONCLUSIONS AND IMPLICATIONS

The aim of our study is to contribute to existing research on Okun's law in Morocco. Using quarterly data covering the period 2000Q1-2022Q4, we examine the dynamics of the relationship between cyclical unemployment and cyclical GDP, as well as the asymmetric behaviour of this relationship. The results of the estimations clearly show that the study of the evolution of the relationship between cyclical output and cyclical unemployment reveals a notable persistence of the unemployment rate, which can be attributed to the presence of unemployment hysteresis effects. On the other hand, analysis of the asymmetry of this relationship during contractions and recessions shows that unemployment fluctuations depend on positive and negative deviations, with the cyclical unemployment rate reacting more strongly to negative deviations in real GDP than to positive deviations, which suggests that the Moroccan economy is unable to generate enough jobs to absorb the increase in the working-age population, and that during recessions the economy loses jobs and the unemployment rate rises as a result.

Based on our analysis, we can suggest that one of the challenges for economic policies in Morocco should focus not only on improving the quality of jobs generated by economic growth, but also on simulating the creation of skilled jobs to meet the constant increase in the number of people of working age. The integration of applicants into the labour market would simultaneously make it possible to increase labour productivity, which has often been considerably below its potential level.

Given the limited capacity of the public sector in Morocco to create a sufficient number of jobs to reduce unemployment, particularly among university graduates, it would make sense for economic policies to prioritise support for the private sector and the promotion of entrepreneurship. With this in mind, subsidising business start-ups and fostering an environment conducive to investment in low-tech sectors could help reduce low-skilled mass unemployment and stimulate the labour market in the short term. In addition, labour market institutions should adapt to alleviate the constraints that limit the willingness and ability of companies to hire young people. With the existence of asymmetry, it is imperative to steer the Moroccan economy towards a process of structural transformation, which generally refers to a sectoral reconfiguration of production and employment and designates a process of transferring resources from the least productive sectors to the most productive sectors, accompanied by a mobility of factors towards new activities, and favours the orientation of public investment towards the most effective job-generating projects. It is also important to invest in areas such as innovation, R&D and digital technology. So training is an essential factor in boosting employment in Morocco. In other words, it is essential to review the education system to better align training with the needs of the production system. In short, active employment policies should be specifically geared towards sectors, young graduates, women and disadvantaged regions where the unemployment rate is particularly high. With this in mind,

a possible extension of this study would be to estimate Okun's relationship by taking into account detailed unemployment rates according to gender, age, sector and region.

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Appendix :

Figure 1: Point cloud.

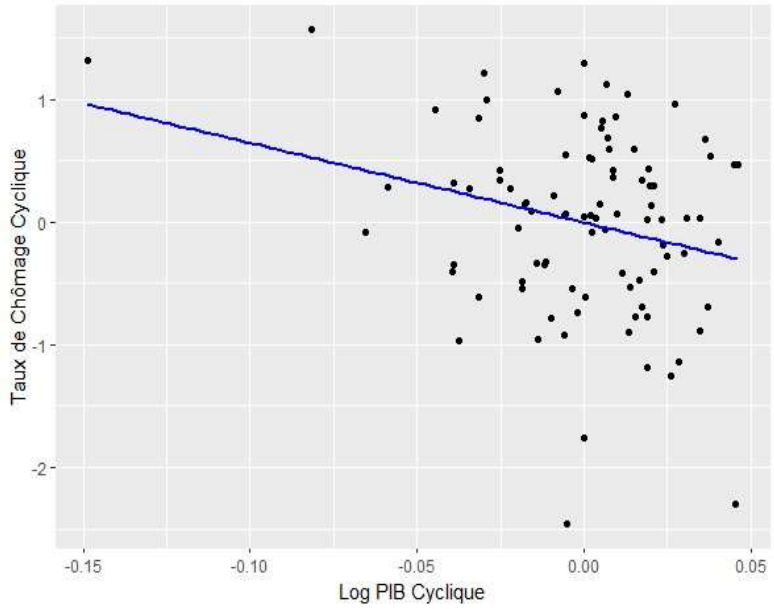


Figure 2: Static model estimation (equation 1).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.85118	3.756104	6.882445	0.0000
β	-1.267423	0.308319	-4.110756	0.0001

R-squared	0.158078	Mean dependent var	10.41848
Adjusted R-squared	0.148724	S.D. dependent var	1.235195
S.E. of regression	1.139648	Akaike info criterion	3.120815
Sum squared resid	116.8918	Schwarz criterion	3.175637
Log likelihood	-141.5575	Hannan-Quinn criter.	3.142942
F-statistic	16.89832	Durbin-Watson stat	1.970428
Prob(F-statistic)	0.000087		

Figure 3: Dynamic model estimation (equation 2).

Dependent Variable: CHOMAGE_CYCLIQUE

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
α_1	0.316898	0.100293	3.159739	0.0022
β	-1.772372	1.378532	-1.285696	0.2019
C	-0.003629	0.072139	-0.050303	0.9600

R-squared	0.126339	Mean dependent var	0.000307
Adjusted R-squared	0.106483	S.D. dependent var	0.727422
S.E. of regression	0.687603	Akaike info criterion	2.121202
Sum squared resid	41.60625	Schwarz criterion	2.203978
Log likelihood	-93.51469	Hannan-Quinn criter.	2.154597
F-statistic	6.362765	Durbin-Watson stat	1.980538
Prob(F-statistic)	0.002625		

Figure 4: Short-term relationship.

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CointEq(-1)*	-0.683102	0.098890	-6.907672	0.0000

R-squared	0.346481	Mean dependent var	-0.000334
Adjusted R-squared	0.346481	S.D. dependent var	0.841064
S.E. of regression	0.679920	Akaike info criterion	2.077246
Sum squared resid	41.60625	Schwarz criterion	2.104838
Log likelihood	-93.51469	Hannan-Quinn criter.	2.088378
Durbin-Watson stat	1.980538		

Figure 5: Long-term relationship.

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003629	0.072139	-0.050303	0.9600
α_1 *	-0.683102	0.100293	-6.811086	0.0000
β **	-1.772372	1.378532	-1.285696	0.2019

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
β	-2.594596	2.010667	-1.290416	0.2003
C	-0.005312	0.105605	-0.050303	0.9600

EC = CHOMAGE_CYCLIQUE - (-2.5946*LOG_PIB_CYCLE -0.0053)

Figure 6: Normality test.

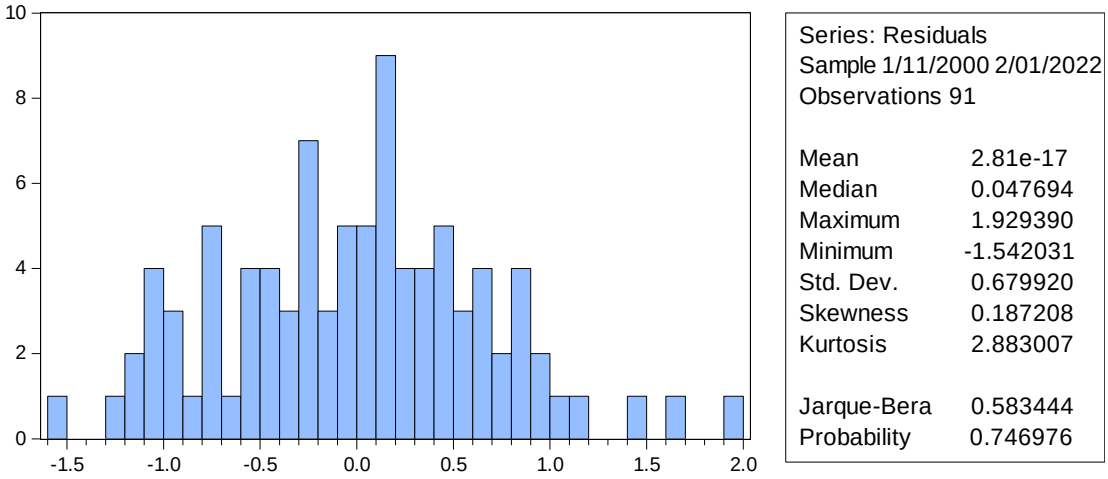


Figure 7: Autocorrelation test.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.050283	Prob. F(2,86)	0.9510
Obs*R-squared	0.106289	Prob. Chi-Square(2)	0.9482

Figure 1: Test d'homoscédasticité.

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.245999	Prob. F(2,88)	0.2927
Obs*R-squared	2.505987	Prob. Chi-Square(2)	0.2856
Scaled explained SS	2.206395	Prob. Chi-Square(2)	0.3318

Figure 2: Estimation récursive.

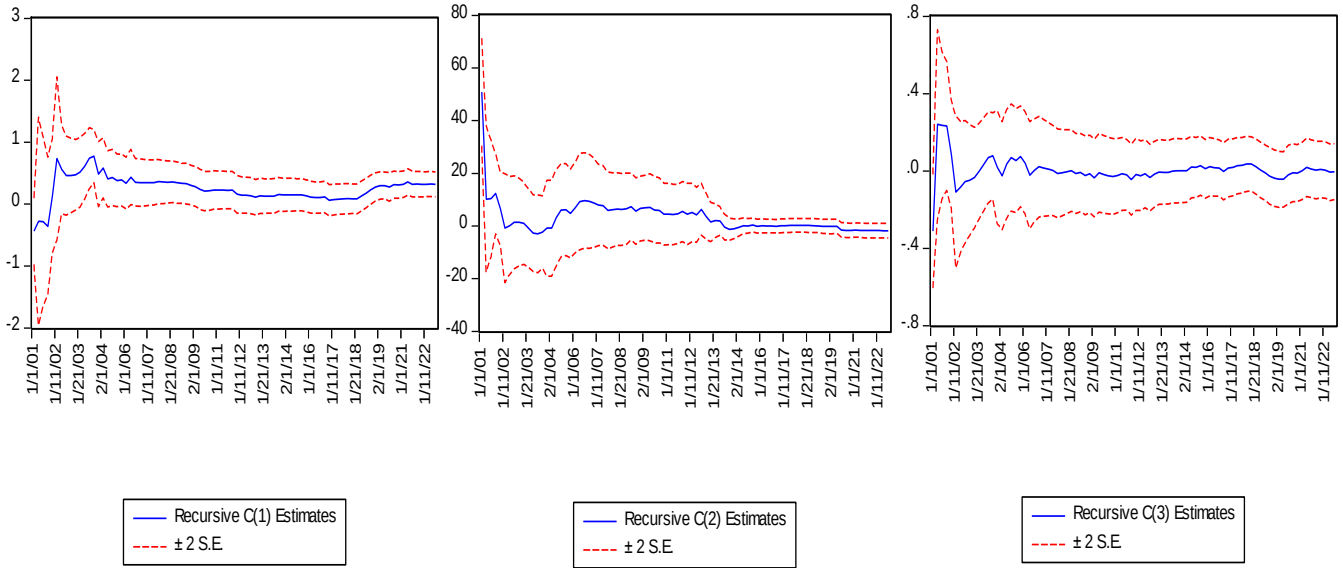


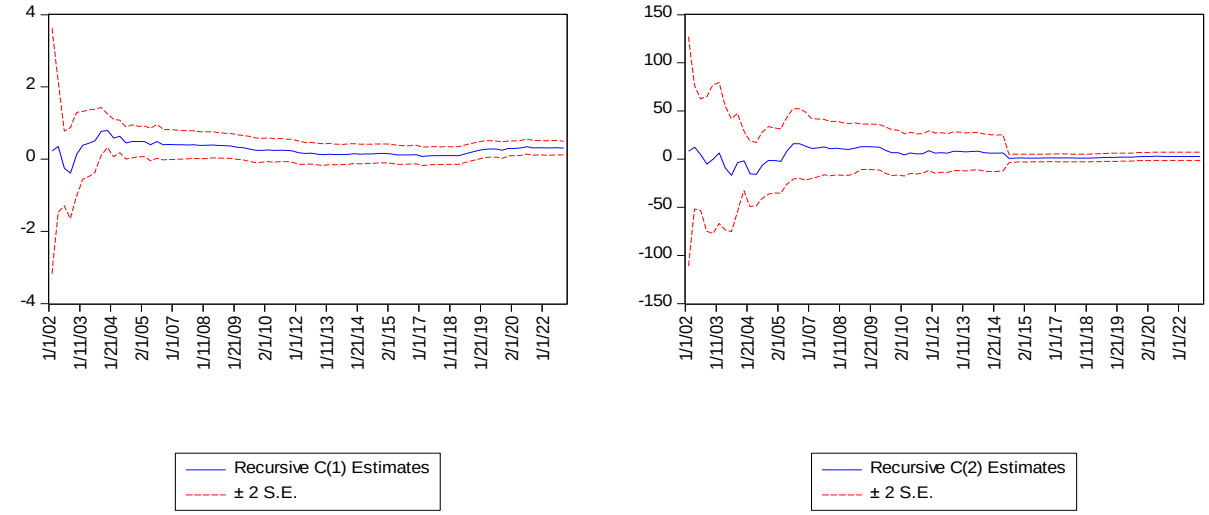
Figure 3: Asymétrie (équation 4).

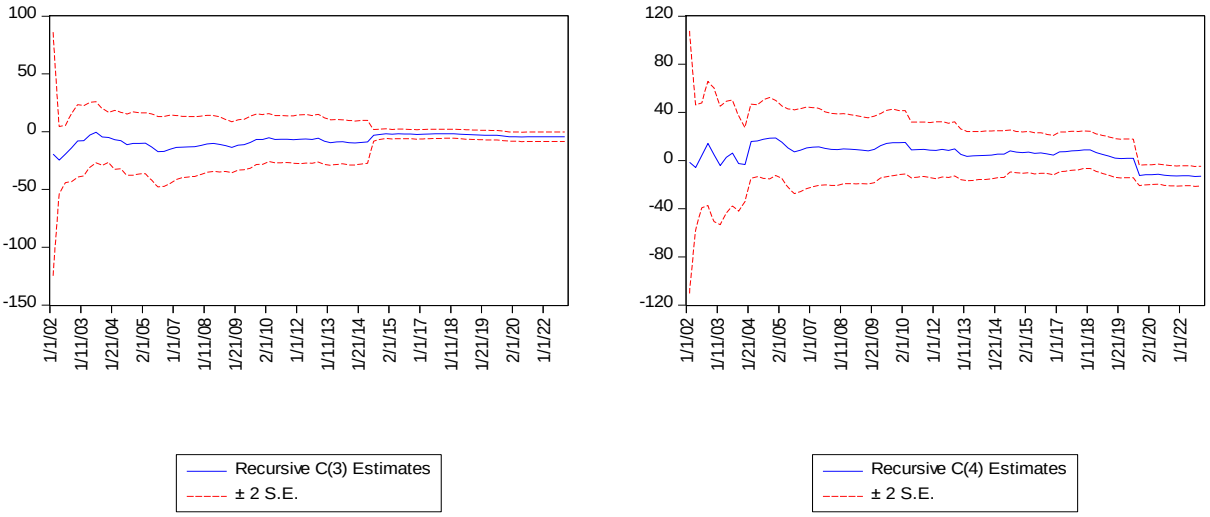
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
α_1	0.304641	0.096978	3.141333	0.0023
β^+	1.844301	2.124726	1.338667	0.1843

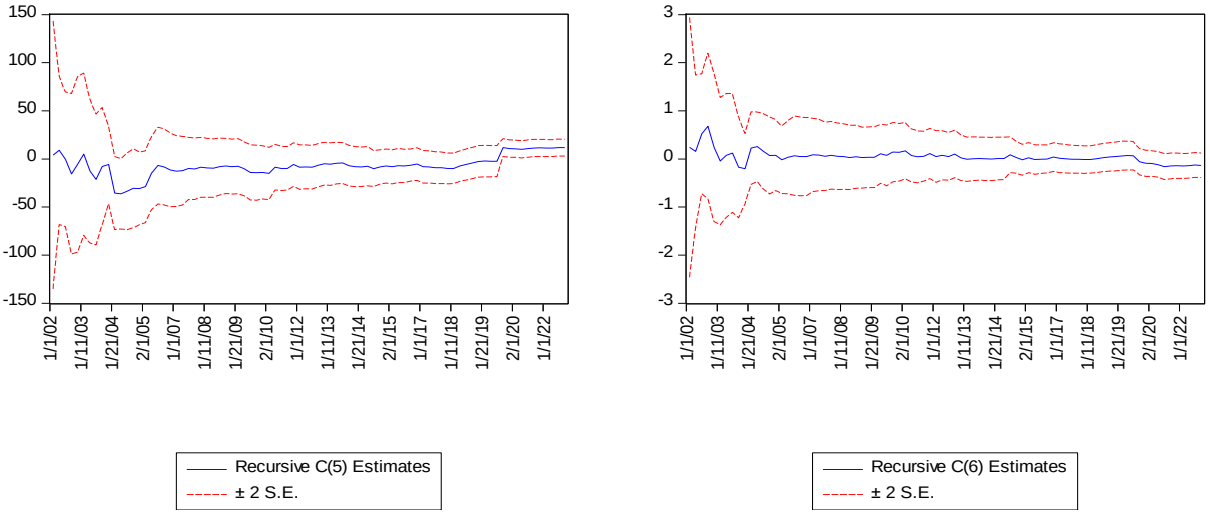
β_1^+	-2.318864	2.013872	-2.144557	0.0349
β^-	-2.996332	4.111034	-3.161329	0.0022
β_1^-	2.640751	4.371121	2.663104	0.0093
C	-0.134577	0.128419	-1.047954	0.2977

R-squared	0.228621	Mean dependent var	-0.004677
Adjusted R-squared	0.182705	S.D. dependent var	0.729933
S.E. of regression	0.659891	Akaike info criterion	2.070858
Sum squared resid	36.57836	Schwarz criterion	2.237512
Log likelihood	-87.18859	Hannan-Quinn criter.	2.138062
F-statistic	4.979164	Durbin-Watson stat	2.044857
Prob(F-statistic)	0.000483		

Figure 4: Estimation récursive (modèle 4).


Recursive C(1) Estimates
± 2 S.E.
Recursive C(2) Estimates
± 2 S.E.


Recursive C(3) Estimates
± 2 S.E.
Recursive C(4) Estimates
± 2 S.E.


Recursive C(5) Estimates
± 2 S.E.
Recursive C(6) Estimates
± 2 S.E.