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Exchange Rate Flexibility and Macroeconomic Stability: A Panel Data Modeling Approach

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Abstract :
The exchange rate regime is a central element of a country's economic policy, playing a crucial role in its macroeconomic stability and global competitiveness. Over the decades, Morocco, like many other countries, has seen its exchange rate regime evolve significantly. After more than ten years under a controlled exchange rate regime, the country adopted a semi-floating exchange rate regime in 2018, characterized by occasional central bank interventions. This transition reflects the fundamental objectives of Moroccan economic policy, aiming to ensure macroeconomic and financial stability, promote economic growth, and foster integration into the global economy. This evolution raises crucial questions about the impact of exchange rate flexibility on macroeconomic instability. This article aims to empirically analyze the impact of exchange rate flexibility on macroeconomic instability by addressing the following central question: To what extent would the Moroccan economy have been unstable if the country had adopted a floating exchange rate regime? Would a floating exchange rate have been preferable to a quasi-fixed regime? To address this issue, our work is structured into two distinct parts. The first part offers a brief literature review on exchange rate regimes and macroeconomic stability, providing a solid theoretical framework. The second part includes an empirical study using panel data from four countries (Morocco, Algeria, Egypt, and Turkey) for a comparative analysis.

Keywords: Exchange rate regime, flexibility, macroeconomic instability, Morocco, panel data, international competitiveness, financial stability, economic policy.

Introduction

The exchange rate regime is a central element of a country's economic policy, playing a crucial role in its macroeconomic stability and global competitiveness. Over the decades, Morocco, like many other countries, has seen its exchange rate regime evolve significantly. After more than ten years under a controlled exchange rate regime, the country adopted, starting in 2018, a semi-floating regime characterized by occasional interventions from the central bank. This transition reflects the fundamental goals of Moroccan economic policy, aimed at ensuring macroeconomic and financial stability, promoting economic growth, and fostering integration into the global economy. This evolution raises crucial questions about the impact of exchange rate flexibility on macroeconomic instability. This research aims to empirically analyze the impact of exchange rate flexibility on macroeconomic instability, addressing the following central question: To what extent would the Moroccan economy have been unstable if the country had adopted a floating exchange rate regime? Would a floating exchange rate have been preferable to a quasi-fixed regime?

To provide answers to this issue, our work is structured into two distinct parts: the first offers a brief literature review on exchange rate regimes and macroeconomic stability, providing a solid theoretical framework. The second part includes an empirical study through panel data modeling across five countries for a comparative analysis.

1. Brief Literature Review

In this first part, we thoroughly explored the fundamental concepts related to exchange rate regimes and macroeconomic stability. Exchange rate regimes and macroeconomic indicators are essential determinants of a country's economic stability. How a country manages its exchange rates and maintains macroeconomic stability can have significant repercussions on investor confidence, household consumption, and economic growth.

In this section, we carefully expanded our literature review by introducing the key concepts of exchange rate regimes and macroeconomic stability. Special attention was given to these concepts, as well as to the determinants of macroeconomic stability and the functioning of different exchange rate regimes, including a comprehensive classification of regime types and an evaluation of the advantages and disadvantages of each. Furthermore, we strengthened our theoretical foundation by exploring various theories that explain the relationship between exchange rate regimes and macroeconomic instability, such as Purchasing Power Parity (PPP), the pass-through effect, the primacy of monetary policy, Mundell's trilemma, and the Balassa-Samuelson effect. Each of these theories offers a distinct perspective on this complex relationship, thereby enriching our overall understanding of the subject.

Indeed, each of these theories offers a distinct perspective on the complex relationship between exchange rate regimes and macroeconomic instability. The theory of Purchasing Power Parity (PPP) highlights the importance of exchange rate adjustments in response to price level differences between countries, while the pass-through theory explores how these fluctuations translate into the prices of imported and exported goods, thereby influencing inflation and competitiveness. The theory of the primacy of monetary policy emphasizes the crucial role of central banks in determining exchange rates, while Mundell's trilemma examines the trade-offs between capital mobility, exchange rate control, and monetary policy autonomy. Finally, the Samuelson-Balassa effect explores the impact of economic openness on income distribution and industry specialization, shedding light on the macroeconomic implications of these phenomena for economic stability.

2. Methodology of the Empirical Work

The empirical analysis in our study follows a quantitative approach, employing panel data modeling to assess the impact of exchange rate flexibility on macroeconomic instability in Morocco. Our research methodology involves gathering and analyzing key macroeconomic indicators, such as inflation, GDP growth, and exchange rates, over a 23-year period.

The use of panel data enables us to conduct a comparative analysis across multiple countries with similar economic structures, providing a robust framework for understanding the effects of various exchange rate regimes. Additionally, we apply statistical tools like regression analysis to test our hypotheses and determine whether a more flexible exchange rate regime could lead to greater macroeconomic stability in Morocco. This methodology ensures that the findings are empirically grounded and offer valuable insights for economic policy formulation.

3. Descriptive Analysis

3.1 Presentation of Variables and Study Model

- In this paragraph, we present the variables used in our study. The variables are divided into two categories: those that measure macroeconomic instability and those that control for other factors that may affect macroeconomic stability.
- We use panel data, meaning we have data on several countries observed at different points in time. We focus on the impact of exchange rate regime flexibility on macroeconomic instability over a 23-year period for four countries. The variables in our study are as follows:
- **Endogenous variable**:
- Macroeconomic instability index
- **Exogenous variables**:
- Real effective exchange rate (REER)
- Unemployment rate
- Inflation rate
- Trade openness rate (TXOV)

Table 1: Presentation of Variables According to the Pre-established Coding

<table>
<tr><th>Variable</th><th>Abbreviation</th><th>Nature</th><th>Data source</th></tr>
<tr><td>Macroeconomic Stability Index (Y)</td><td>MSI</td><td>Endogenous variable</td><td rowspan="5">World Bank (WB): Countries International

Monetary Fund (IMF):
IMF Data</td></tr>
<tr><td>Real Effective Exchange Rate (X_1)</td><td>REER</td><td>Variable of interest</td></tr>
<tr><td>Unemployment Rate (X_2)</td><td>UR</td><td rowspan="3">Control variables</td></tr>
<tr><td>Inflation Rate (X_3)</td><td>IR</td></tr>
<tr><td>Trade Openness Rate (X_4)</td><td>TOR</td></tr>
</table>

Source: Developed by the authors

3.1 Spécification du modèle

The panel data model can be formulated for N countries (i = 1,…,5) and T time observations (t = 1,…,23), thus totaling n = N × T = 115 observations, as follows :

$y_{it} = a_{oi} + a'_i \, x_{it} + \varepsilon_{it}$ with : t =1,2,….,T and i=1,2,….N

y_{it} : the endogenous variable observed for individual *i* at period *t*

x_{it} : vector of the *k* exogenous variables $x_{it} = (x_{1it} , x_{2it} ,…., x_{kit})$

a_{oi} : constant term for individual i,

a'_i : vector of the *k* coefficients of the *k* exogenous variables $a'_i = (a_{1i} , a_{2i} , …, a_{ki})$

ε_{it} : error term

4. Study of Stationarity

4.1 Levin-Lin-Chu Unit Root Test

The Levin-Lin-Chu unit root test is used to assess stationarity in time series. It examines the presence of unit roots, an indicator of non-stationarity. By comparing the test statistics to critical thresholds, it determines whether the time series is stationary, which is an essential consideration in the analysis of time series data.

Figure 1: Results of the Levin-Lin-Chu Unit Root Test

Null Hypothesis: Unit root (common unit root process)
Series: ISM
Date: 01/01/24 Time: 22:21
Sample: 2000 2022
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 105
Cross-sections included: 5

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.57454	0.2828

** Probabilities are computed assuming asympotic normality

Intermediate results on ISM

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
Maroc	-0.05499	0.0052	0.0054	1	1	0.0	21
Turquie	-0.36652	0.0025	0.0018	1	1	4.0	21
Tunisie	-0.26948	0.0187	0.0060	1	1	6.0	21
Egypte	-0.45379	0.0239	0.0157	1	1	6.0	21
Algerie	-0.08565	0.0030	0.0005	1	1	21.0	21

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.19163	-3.059	1.028	-0.554	0.919		105

Source: Developed by the authors

The figure below shows that the p-value > 0.05, which leads us to accept the null hypothesis and indicates that the panel contains a unit root.

4.2 Hadri LM Test

The Hadri LM test, or Hadri stationarity test, assesses stationarity in time series. It is designed to detect both linear and nonlinear trends. By comparing the test statistics to critical values, it helps determine whether the time series is stationary, which is crucial in the analysis of time series data.

Figure 1 : Results of the Hadri LM Test

Null Hypothesis: Stationarity
Series: ISM
Date: 01/01/24 Time: 22:33
Sample: 2000 2022
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 115
Cross-sections included: 5

Method	Statistic	Prob.**
Hadri Z-stat	5.00201	0.0000
Heteroscedastic Consistent Z-stat	4.52663	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on ISM

Cross section	LM	Variance HAC	Bandwidth	Obs
Maroc	0.2441	0.014437	2.0	23
Turquie	0.5245	0.010466	2.0	23
Tunisie	0.4975	0.085148	3.0	23
Egypte	0.4089	0.116399	2.0	23
Algerie	0.6671	0.085499	3.0	23

Source: Developed by the authors

The results of the stationarity test lead us to accept the null hypothesis, indicating the presence of a unit root in the panel.

4.3 Fisher Type Unit Root Test (Based on ADF)

The Fisher Type Unit Root Test, based on the Augmented Dickey-Fuller test, assesses the presence of unit roots in a time series. It extends the Dickey-Fuller test by incorporating explanatory variables to enhance the test's power. By comparing the test statistics to critical thresholds, it helps determine whether the time series has a unit root, which is essential information for the analysis of stationarity.

Figure 2: Results of the Fisher Type Unit Root Test (Based on ADF)

Null Hypothesis: Unit root (individual unit root process)
Series: ISM
Date: 01/01/24 Time: 22:57
Sample: 2000 2022
Exogenous variables: Individual effects, individual linear trends
User-specified lags: 1
Total (balanced) observations: 105
Cross-sections included: 5

Method	Statistic	Prob.**
ADF - Fisher Chi-square	13.4148	0.2014
ADF - Choi Z-stat	-0.47863	0.3161

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results ISM

Cross section	Prob.	Lag	Max Lag	Obs
Maroc	0.9922	1	1	21
Turquie	0.2533	1	1	21
Tunisie	0.1381	1	1	21
Egypte	0.2746	1	1	21
Algerie	0.1282	1	1	21

Source : Developed by the authors

The test results show that the "p-value" associated with the inverse chi-squared is 0.2014, which is greater than 5%. This leads us to accept the null hypothesis of the presence of a unit root.

4.4 Fisher-Type Unit Root Test Based on Phillips-Perron

The Fisher-Type Unit Root Test, based on Phillips-Perron, assesses the presence of unit roots in a time series. It relies on the Phillips-Perron method to detect non-stationarity, accounting for deterministic trends and autocorrelations. By comparing the test statistics to critical thresholds, it helps determine whether the time series has a unit root, which is crucial for the analysis of stationarity.

Figure 3: Results of the Fisher-Type Unit Root Test (Based on Phillips-Perron)

Null Hypothesis: Unit root (individual unit root process)
Series: ISM
Date: 01/01/24 Time: 23:13
Sample: 2000 2022
Exogenous variables: Individual effects, individual linear trends
Newey-West automatic bandwidth selection and Bartlett ke...
Total (balanced) observations: 110
Cross-sections included: 5

Method	Statistic	Prob.**
PP - Fisher Chi-square	16.5624	0.0846
PP - Choi Z-stat	-0.87693	0.1903

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results ISM

Cross section	Prob.	Bandwidth	Obs
Maroc	0.9275	0.0	22
Turquie	0.3073	0.0	22
Tunisie	0.2031	1.0	22
Egypte	0.6509	3.0	22
Algerie	0.0067	2.0	22

Source: Developed by the authors

The figure above presents the results of the Fisher-Type Unit Root Test based on Phillips-Perron, which confirm the conclusions of the previous test. In particular, the "p" value associated with the modified inverse chi-squared is 0.0846, exceeding the 5% threshold. These various tests converge towards the conclusion that the series is not stationary, indicating the need to make it stationary.

5.Residual Tests

In the continuation of our empirical methodology, the following paragraph will focus on an in-depth exploration of the residual tests. These tests play a crucial role in evaluating the validity of our model, allowing us to detect any potential violations of the underlying assumptions of our analyses. By examining the distribution and behavior of the residuals, we aim to assess the relevance of our model, identifying any signs of autocorrelation or heteroscedasticity. This methodological phase is of paramount importance in validating our results, contributing to the credibility of our conclusions and the reliability of our empirical approach.

5.1 Heteroscedasticity Tests

Heteroscedasticity tests for panel data assess the presence of unequal variance disparities in the residuals across different panel units. These tests, such as the Breusch-Pagan test, examine whether the variance of the regression errors varies systematically with the values of the explanatory variables. Detecting heteroscedasticity is crucial for ensuring the reliability of the estimates in panel data analysis.

The LR test for heteroscedasticity is a statistical test used to detect heteroscedasticity in regression models. The null hypothesis of the test is that the residuals of the model have a constant variance, while the alternative hypothesis is that the residuals have a variable variance. The LR test is based on regressing the squared residuals from the original regression model on the independent variables. If the coefficients of the regression of the squared residuals are significant, then the null hypothesis is rejected, indicating the presence of heteroscedasticity.

Figure 4: Results of the LR Test for Heteroscedasticity

Panel Cross-section Heteroskedasticity LR Test
Equation: UNTITLED
Specification: ISM CSP TCER TXCH TXCR TXINF C
Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	44.92352	5	0.0000

LR test summary:

	Value	df
Restricted LogL	68.81233	109
Unrestricted LogL	91.27409	109

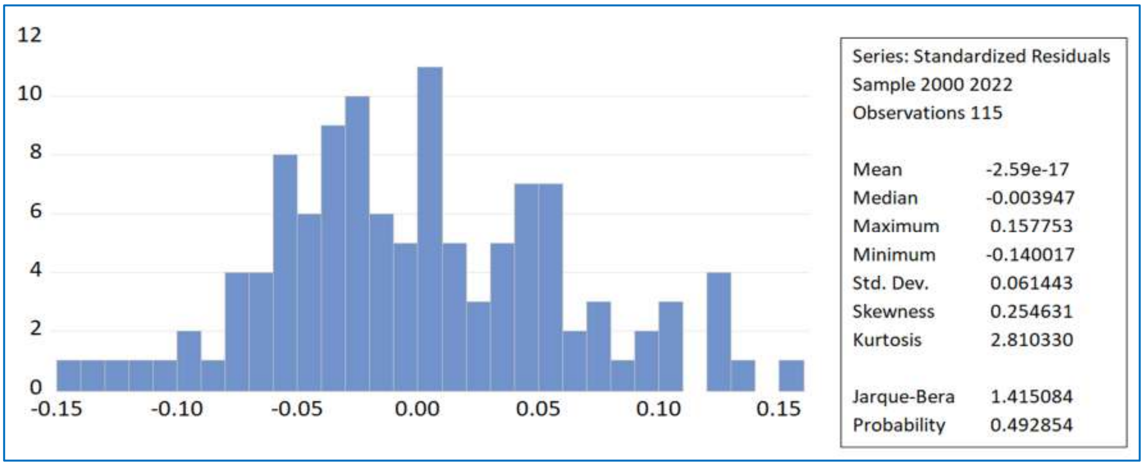
Source : Developed by the authors

In the figure above, the value of the LR test for heteroscedasticity is below the significance threshold of 0.05. This indicates that the residuals of the model are homoscedastic.

5.2 Normality Tests

The normality test for errors in a panel model assesses whether the residuals of the model follow a normal distribution. Statistical tests, such as the Jarque-Bera test, are applied to examine the normality of the residuals across different panel units. The normality of errors is important to ensure the validity of statistical inferences in panel data analysis.

Figure 5 : Results of the Jarque-Bera Normality Test



Source: Developed by the authors

The figure above shows that the Jarque-Bera probability of 0.49 suggests that the residuals of the panel model do not exhibit significant signs of non-normality, at least according to the conventional significance threshold of 5%. This indicates that, based on the Jarque-Bera test, there is not enough evidence to reject the null hypothesis of normality of the residuals. In other words, the residuals appear to follow a normal distribution, which is favorable for the validity of statistical conclusions in the panel model.

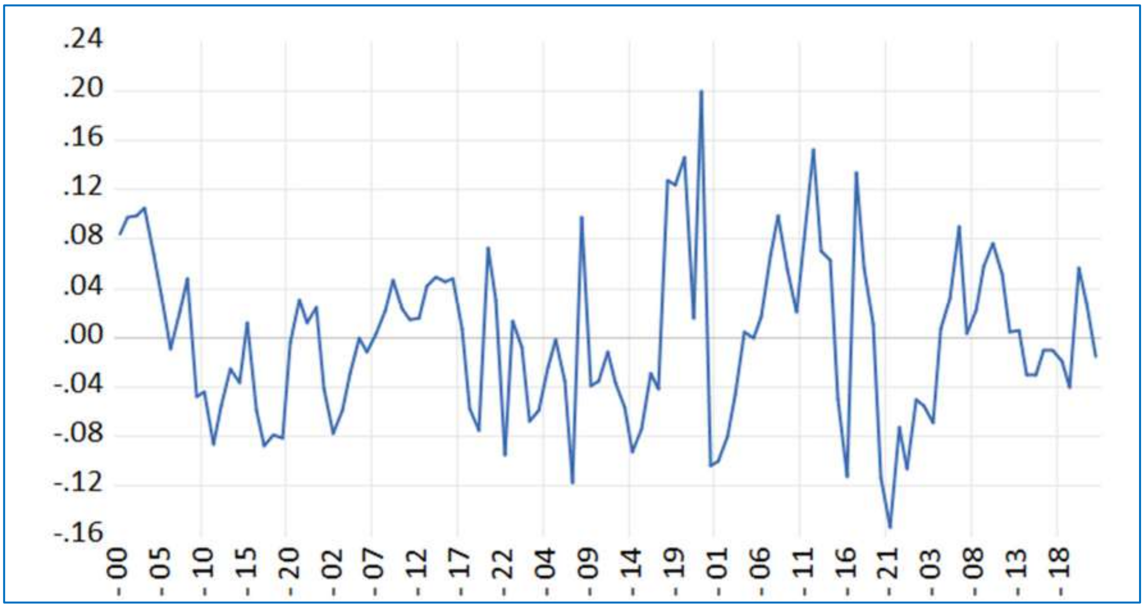
5.3 Error Autocorrelation Tests

Error autocorrelation tests in panel data assess the presence of serial correlation in the model's residuals. These tests, such as the Durbin-Watson test or the Breusch-Godfrey test, examine whether the errors exhibit temporal dependence. Detecting autocorrelation is crucial to ensuring the efficiency and validity of estimates in data analysis. Appropriate adjustments may be necessary if autocorrelation is detected.

- **Visual Examination of Residuals**

The visual analysis of the model's residuals involves graphical examination to detect any potential trends. This method provides an initial impression regarding the potential presence of autocorrelation in the model's errors.

Figure 6: Visual Examination of Ressiduals



Source: Developed by the authors

The presented graph reveals a configuration of residuals forming a wavy band, suggesting the presence of positive autocorrelation of errors.

- **Breusch-Godfrey Test (Serial Correlation LM)**

The Breusch-Godfrey test, also known as the Serial Correlation LM test, assesses the presence of serial autocorrelation in the residuals of a regression model. It uses an LM (Lagrange Multiplier) statistic to test the null hypothesis of no autocorrelation up to a certain lag. Significant results indicate the presence of autocorrelation, suggesting the need for adjustments in the model to ensure reliable estimates.

Figure 7: Results of the Breusch-Godfrey Test (Serial Correlation LM)

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	16.87388	Prob. F(2,98)	0.0000
Obs*R-squared	29.45775	Prob. Chi-Square(2)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 01/03/24 Time: 10:10
Sample: 1 115
Included observations: 115
Presample missing value lagged residuals set to zero.

Source : Developed by the authors

The presented figure indicates that the calculated probability (Obs*R-squared) is less than 0.05, leading to the rejection of the null hypothesis. Therefore, this suggests that the errors of the model exhibit autocorrelation.

6. Panel Structure and Homogeneity Tests (Hsiao Test)

The Hsiao test is a statistical method used in panel data analysis to assess the validity of the hypothesis of no serial correlation of errors. It examines whether unobserved individual errors are correlated over time. If the test reveals significant correlation, it suggests that individual errors are not strictly independent, calling into question the adequacy of the panel model used.

To conduct the Hsiao Test, we start by testing the hypothesis H_0^1 , The hypotheses of the test are : H_0^1 : $a_{oi} = a_o$ et $a_i' = a'$ (Total Homogeneity).

The statistic used for constructing this test is the Fisher statistic given by :

$$F_c^1 = \frac{(SCR_1 - SCR)/(N-1)\,(k+1)}{SCR/(N*T-N(k+1))} \quad \text{et} \quad F_{th}^1 = \text{F}\ (\alpha\ ;\ (N-1)\,(k+1)\ ;\ (N*T-N(k+1)\,)$$

With :

SCR_1 : Sum of squared residuals of the constrained model under the hypothesis H_0^1 , Let the model be estimated using OLS by stacking all observations. The degrees of freedom is equal to : (N×T) – (k + 1). With : (N×T) = Total number of observations.) and (k + 1) = Number of coefficients to estimate.

SCR = The sum of squared residuals of the unconstrained model is equal to the sum of the N sums of squared residuals of the models estimated on the T observations of each individual equation. SCR = $\sum_{i=1}^{N} SCR_i$.

Table 2: Results of the Estimation of the Model with Stacked Data

Variable	Coefficient	Prob
REER	-0.142331	0.0003
IR	0.005307	0.0000
UR	0.023592	0.0000
TOR	0.018946	0.9053

Source: Developed by the authors

According to the figure above, the sum of squared residuals of the constrained model under the hypothesis H_0^1 est SCR_1 = 2,047.

Table 3: Estimation results of the models for the 5 countries.

Country	SCR
Morocco	0,00000025
Turkey	0,00000103
Egypt	0,000000234
Tunisia	0.00000149
Algeria	0,000000166
Sum	0,000002079

Source : Developed by the authors

SCR = $\sum_{i=1}^{N} SCR_i = \sum_{i=1}^{5} SCR_i$ = 0,00000193

$$F_c^1 = \frac{(SCR_1 - SCR)/(N-1)\,(k+1)}{SCR/(N*T - N(k+1))} = \frac{(2{,}047 - 0{,}000002079)/(5-1)\,(9+1)}{0{,}000002079/(5*23 - 5(9+1))} = 1599831{,}65$$

et F_{th}^1 = F $(\alpha\,;\,(N-1)\,(k+1)\,;\,(N*T - N(k+1)\,)$ = F $(5\%\,;\,(5-1)\,(9+1)\,;\,(5*23 - 5(9+1)\,)$ = F $(5\%\,;40\,;65\,)$ = 1,51

$F_c^1 > F_{th}^1$ So, we reject the hypothesis. H_0^1 . We move towards the left side of the figure above, that is, to test the hypothesis H_0^2 .

We calculate SCR_{c2} = SCR of the constrained model under the hypothesis H_0^2 , that is, to estimate the individual fixed effects model.

7. Fixed effect or random effect: Hausman test

The Hausman test is an essential tool in the field of panel data models, allowing for the choice between a fixed effects model and a random effects model. This test aims to assess the relevance of the model choice by comparing the estimates from the two approaches. The Hausman test examines whether the differences between fixed and random effects are systematic or random.

Figure 10: Results of the Hausman test

Correlated Random Effects - Hausman Test
Equation: EQ04VA
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	172.769442	4	0.0000

REER
IR
UR
TOR

section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
TCER	0.183264	-0.142331	0.007667	0.0002
TXINF	0.003954	0.005307	0.000000	0.0000
TXCH	0.027853	0.023592	0.000001	0.0004
TXOV	2.881401	0.018946	0.048737	0.0000

Source: Developed by the authors

The results of the test indicate a probability of less than 5%, leading us to reject the null hypothesis, justifying the use of fixed effects, which are more general than random effects and do not impose a structure on individual effects. However, choosing fixed effects results in a loss of N-1 degrees of freedom, making the estimation of the coefficients of the explanatory variables less efficient. Furthermore, the coefficient of any time-constant explanatory variable for the same individual (country) is not estimable, as the "within" estimator eliminates it. Thus, the Hausman test led us to favor the fixed effects model.

- **Estimation of the fixed effects model**

In light of the significant results obtained from the Hausman tests, it is established that the model under investigation is characterized by fixed effects. Thus, in this paragraph dedicated to the estimation of the fixed effects model.

Figure 11: Results of the estimation of the fixed effects model

REER
IR
UR
TOR
C

Dependent Variable: ISM
Method: Panel Least Squares
Date: 02/11/24 Time: 13:00
Sample: 2000 2022
Periods included: 23
Cross-sections included: 5
Total panel (balanced) observations: 115

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TCER	0.183264	0.090824	2.017789	0.0461
TXINF	0.003954	0.000752	5.258331	0.0000
TXCH	0.027853	0.002647	10.52346	0.0000
TXOV	2.881401	0.242270	11.89333	0.0000
C	-0.829837	0.090738	-9.145429	0.0000

Effects Specification

Cross-section fixed (dummy variables)

Root MSE	0.082276	R-squared	0.776897
Mean dependent var	0.439150	Adjusted R-squared	0.760059
S.D. dependent var	0.174952	S.E. of regression	0.085698
Akaike info criterion	-2.000943	Sum squared resid	0.778482
Schwarz criterion	-1.786122	Log likelihood	124.0542
Hannan-Quinn criter.	-1.913748	F-statistic	46.13961
Durbin-Watson stat	0.591465	Prob(F-statistic)	0.000000

Source: Developed by the authors

The results of the fixed effects model reveal significant influences on macroeconomic stability, highlighting several crucial trends. A positive coefficient of 0.183 for the real effective exchange rate (REER) with a p-value of 0.0461 suggests that an increase in the REER is associated with an increase in the macroeconomic instability index, indicating a positive relationship between REER and macroeconomic instability. Furthermore, a positive coefficient of 0.003 for the inflation rate with a p-value close to zero shows that higher levels of inflation increase the MII, which can be explained by the negative effects of inflation on economic stability. The positive coefficient of 0.027853 for the unemployment rate with a p-value close to zero suggests that higher unemployment rates also increase the macroeconomic instability, reflecting the negative impact of unemployment on economic stability. Additionally, a substantial positive coefficient of 2.881401 for the openness rate with a p-value close to zero indicates a strong positive association between the openness rate and the MII, suggesting that more open economies are more likely to experience macroeconomic instability. The significant Fisher F-statistic test (with a p-value close to zero) indicates that the set of independent variables has a significant effect on the MII, and the low AIC suggests a good fit of the model while penalizing complexity. However, the Durbin-Watson statistic of 0.591 suggests positive residual autocorrelation. The inclusion of fixed effects through cross-sectional dummy variables shows that certain characteristics specific to each unit of the panel influence the MII, even after controlling for the independent variables.

8. Comparative study

- **Countries with a fixed exchange rate regime**

In this paragraph, we initiate a crucial phase of our analysis focused on estimating the model for countries operating under a fixed exchange rate regime. More specifically, we will examine two major players, namely Morocco and Algeria.

This step is of paramount importance, as it will allow us to dissect the underlying mechanisms of fixed exchange rate regimes, highlighting the dynamics specific to these economies and their reactions to external factors. By concentrating specifically on Morocco and Algeria, two countries sharing a common characteristic of a fixed exchange rate regime, our goal is to provide an in-depth understanding of the implications of this stability on macroeconomic stability, inflation, foreign exchange reserves, and other key indicators.

The results of the model for countries with a fixed exchange rate regime provide significant insights into the relationships between exchange rate stability and the macroeconomic instability index.

REER (Real Effective Exchange Rate): The negative coefficient of -0.182 associated with REER indicates an inverse relationship with the macroeconomic instability index (MII). In other words, a decrease in the real effective exchange rate is linked to an increase in macroeconomic instability. This result suggests that, in the context of fixed exchange rate regimes, an appreciation of the currency could contribute to greater macroeconomic stability.

NOMINAL EXCHANGE RATE: The positive coefficient of 1.732 for the nominal exchange rate suggests that an increase in the nominal exchange rate is strongly correlated with an increase in macroeconomic instability. This indicates that significant fluctuations in the nominal exchange rate may be associated with higher levels of macroeconomic instability in the examined countries.

INFLATION RATE: The positive coefficient of 0.004 for the inflation rate indicates a positive relationship between inflation and macroeconomic instability. Thus, an increase in inflation is associated with an increase in macroeconomic instability in the context of the fixed exchange rate regime.

OPENNESS RATE: The positive coefficient of 1.476 for the openness rate suggests that higher levels of economic openness are correlated with greater macroeconomic instability in the countries studied under a fixed exchange rate regime.

- **Countries with a floating exchange rate regime**

In the same framework, we now direct our analysis towards the estimation of the model applicable to countries operating under a floating exchange rate regime. To shed light on these dynamics, we focus specifically on two major players in the region, namely Egypt and Turkey.

This phase of the study is crucial as it will allow us to untangle the underlying mechanisms of floating exchange rate regimes, highlighting the interactions between monetary policy, exchange rate volatility, and the macroeconomic challenges specific to these two economies. By focusing on Egypt and Turkey, two countries sharing the common characteristic of increased flexibility in their exchange rate regimes, our goal is to provide a thorough understanding of the implications of this flexibility on macroeconomic stability, inflation, foreign exchange reserves, and other crucial indicators.

The results of the model for countries with a floating exchange rate regime provide essential insights into the relationship between the considered variables and the macroeconomic instability index.

REER (Real Effective Exchange Rate): The coefficient of 0.105 associated with REER is positive but not statistically significant (Prob = 0.577). This indicates that, in the context of floating exchange rate regimes for Egypt and Turkey, the real effective exchange rate does not have a significant relationship with macroeconomic instability.

UNEMPLOYMENT RATE: The substantial positive coefficient of 5.547016 for the unemployment rate suggests a strong positive correlation between changes in the unemployment rate and macroeconomic instability. An increase in the unemployment rate is associated with a significant rise in macroeconomic instability in these countries.

INFLATION RATE: The coefficient of 0.003862 for the inflation rate is positive and highly significant (Prob. = 0.0000), indicating a positive relationship between the inflation rate and macroeconomic instability. An increase in inflation is strongly associated with an increase in macroeconomic instability in the context of floating exchange rate regimes.

OPENNESS RATE: The coefficient of 4.169068 for the openness rate is positive and very significant, suggesting a strong positive correlation between the openness rate and macroeconomic instability. A more open economy is linked to increased macroeconomic instability.

Table 4: Summary table of the comparison results of the two groups of countries

Variable	Fixed Regime (Morocco and Algeria)	Floating Regime (Egypt and Turkey)
REER	Negative, Significant	Positive, Not Significant
UNEMPLOYMENT RATE	Positive, Inversely Correlated with Instability	Positive, Strongly Correlated with Instability
INFLATION RATE	Positive, Significant	Positive, Significant
OPENNESS RATE	Positive, Significant	Positive, Significant

Source : Developed by the authors

Conclusion

At the conclusion of this chapter, which attempts to model the impact of exchange rate flexibility on macroeconomic instability in Morocco, we begin with a review of empirical literature examining the links between the exchange rate regime and various macroeconomic indicators.

The studies highlight the interconnection between exchange rate depreciation, inflation, the exchange rate regime, economic growth, and foreign direct investment (FDI), revealing important trends and key determinants. The empirical results show divergent outcomes, emphasizing the complexity of the relationships and the importance of considering economic specifics to formulate effective macroeconomic policies. This work contributes to the literature by providing new evidence of the impact of exchange rate regimes on macroeconomic instability, particularly in Morocco. Previous research has shown contradictory results regarding the effect of exchange rates on economic growth, underscoring the need for a contextual approach to choosing the appropriate exchange rate regime. Finally, studies on devaluations, primarily concentrated in developed countries, justify the need for further research, particularly in developing countries like Morocco. Subsequently, we engage in an exploration through panel modeling.

The results of the model for countries with a fixed exchange rate regime provide significant insights into the relationships between exchange rate stability and the macroeconomic instability index (MII). The negative coefficient of -0.182 associated with the real effective exchange rate (REER) indicates that a decrease in this rate is linked to an increase in macroeconomic instability, suggesting that currency appreciation contributes to greater macroeconomic stability. In contrast, the positive coefficient of

1.732 for the nominal exchange rate (NOMINAL EXCHANGE RATE) shows that an increase in this rate is strongly correlated with a rise in macroeconomic instability, indicating that significant fluctuations in the nominal exchange rate are associated with higher levels of instability. The positive coefficient of 0.004 for the inflation rate (INFLATION RATE) reveals a positive relationship between inflation and macroeconomic instability, suggesting that rising inflation increases instability. Finally, the positive coefficient of 1.476 for the openness rate (OPENNESS RATE) indicates that higher levels of economic openness are correlated with greater macroeconomic instability in the countries examined under a fixed exchange rate regime.

The results of the model for countries with a floating exchange rate regime provide essential insights into the relationship between the considered variables and the macroeconomic instability index (MII). The coefficient of 0.105 associated with the real effective exchange rate (REER) is positive but not significant (Prob = 0.577), indicating that the REER does not have a significant relationship with macroeconomic instability in Egypt and Turkey. In contrast, the substantial coefficient of 5.547 for the unemployment rate (UNEMPLOYMENT RATE) suggests a strong positive correlation between changes in unemployment and macroeconomic instability, where an increase in unemployment significantly raises instability. The coefficient of 0.003862 for the inflation rate (INFLATION RATE) is positive and highly significant (Prob. = 0.0000), showing that a rise in inflation is strongly associated with an increase in macroeconomic instability. Finally, the coefficient of 4.169 for the openness rate (OPENNESS RATE) is positive and very significant, suggesting that a more open economy is correlated with increased macroeconomic instability in the context of floating exchange rate regimes.

this work reviews empirical literature on the impact of exchange rate flexibility on macroeconomic instability in Morocco, highlighting the interconnectedness of exchange rate depreciation, inflation, economic growth, and foreign direct investment. The findings reveal complex relationships and underscore the need for context-specific approaches to exchange rate regimes. The model results show that for countries with a fixed exchange rate, a decrease in the real effective exchange rate is linked to increased macroeconomic instability, while a significant rise in the nominal exchange rate correlates with higher instability. For countries with a floating exchange rate, the unemployment rate and inflation are positively correlated with macroeconomic instability, with higher economic openness also associated with increased instability. Overall, this work contributes new evidence to the literature on exchange rate regimes and macroeconomic instability, particularly in the context of Morocco.

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