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Measurement and Analysis of Macroeconomic (In)stability in North African Countries

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ABSTRACT

This paper aims to analysis the macroeconomic (in)stability in four North African countries (Algeria, Egypt, Morocco, and Tunisia) covering the period 1999 to 2018 from the databases of World Bank (WDI). To achieve this purpose, we have modified the Macroeconomic Instability Index (MII) by adding a fifth variable to the four variables adopted in the previous economic literature. Also, the study investigates the major factors influencing macroeconomic stability for North African countries. The study uses the panel regressing approach especially; the Panel FGLS, which takes into account the fixed and random effects across countries and periods, and Panel FMOLS and DOLS which estimate and illustrate the long-term cointegration relationships. The results of measuring the stability index for the countries under study correspond to the facts and economic events that these countries witnessed during the study period, especially Egypt and Tunisia. The findings highlight, money supply, exports, and domestic investments have a strong statistically significant relationship with a negative sign while import has strong significant a positive effect on MII. According to the results achieved through standard economic analysis, along with some economic characteristics of North African countries, trade, investment and monetary policy are among the important factors in achieving macroeconomic stability. The study recommends economic policymakers in North African countries must work to enhance foreign trade, benefiting from the geographical location and based on the ingredients had by those countries, while identifying factors that promote exports.

INTRODUCTION

The concept of macroeconomic stability has suffered important changes during the economic course of the previous decades because of globalization and international integration between nations. During the years after the war II, a period dominated by the Keynesian concept, macroeconomic stability meant a combination of external and internal balance, which means a full labor occupancy and a stable economic growth, accompanied by decreased inflation. After that, fiscal balance and the establishment of prices became the center of attention, replacing the Keynesian focus on real economic activity. This change of policy has led to minimizing the role of macroeconomic policy anti-cyclic (Stiglitz, 2003). There is a consensus that economic events related to economic and financial crises cause negative effects on the living standards that can result from macroeconomic instability (Furman et al., 1998). Large fluctuations in economic activity, exchange rates, and financial markets, high levels of inflation and debt, all lead to higher rates of unemployment and poverty, so keeping macroeconomic stability is a necessary requirement for achieving sustainable and comprehensive development. The recent financial crisis 2008 has highlighted the negative economic effects, which can result from macroeconomic instability. Macroeconomic stability shows how a national economy creates its structure for sustainable growth and, in the meantime, how it minimizes its vulnerability to external shocks. The main aim of macroeconomic policy is to contribute to economic growth, social well-being, and economic welfare equitably and durably. Macroeconomic stability acts as a safety margin against currency and interest rate fluctuations in the market. Exposure to currency fluctuations, excessive indebtedness, and inflation that cannot control may lead to an economic crisis and even cause the collapse of the gross domestic product.

Many economists seek to research the reasons for achieving sustainable economic growth by identifying and studying factors of macroeconomic stability in many countries. Moreover, Montiel and Servén (2006) emphasize that most developing countries have suffered from macroeconomic instability compared to industrialized economies. Hurduzeu and Lazăr (2015) determine that there are five important indicators necessary to make up the element of macroeconomic stability in any economy: economic growth rate, unemployment rate, Inflation rate, budget balance, and current account balance. Also, several empirical literatures have shown which applied in most countries the importance of achieving macroeconomic stability. And why are some countries more stable macroeconomic than others? Therefore, the problem of the study revolves around measuring the macroeconomic stability index in North African countries, while identifying the factors that achieve macroeconomic stability in these countries. So, this study focuses on the analysis of the North African countries' economy is fairly explaining the connection between macroeconomic stability and many economic variables such as exports, imports, money supply, and domestic investment, especially in the last two decades (1999- 2018). It is surprising that while so much of the recent literature has focused and Interested by explaining the among country variation in real variables such as income (Acemoglu and Angrist , 2001; Hausmann et al., 2005), in growth (Barro and Sala-i-Martin, 2003) and the instability of growth (Acemoglu et al., 2003a), There was a shortage of studying and analyzing the macroeconomic stability. So the principal aim of this study is to measure the Macroeconomic instability index in North African countries and illustrate the determinants of economic stability in these countries.

The study will verify the following assumptions: The rise in the macroeconomic instability index in North African countries, especially in recent years. Exports, imports, money supply, and domestic investment affect macroeconomic stability. The remaining sections of the study organized as follows: Section 1 Introduction, Section 2 briefly reviews the literature on macroeconomic stability, while section 3 describes diverse methods to measure the macroeconomic (in)stability index. Section 4 discusses econometric techniques used in Empirical Study: Methodology and formwork and investigate some implications of the findings, and finally the conclusions and policy implications are presented in section 5.

1. LITERATURE REVIEW

There are many theoretical and empirical studies that have investigated the importance of achieving macroeconomic stability and its effects both on many economic variables such as economic growth, or

the effect of some economic variables on macroeconomic stability. Several pioneer studies examined the issue of macroeconomic instability such as Frenkel and Khan (1990), Fischer (1993), Easterly and Rebelo (1993). Several empirical studies investigated and estimated macroeconomic instability proxies against economic growth such as Dornbusch and Edwards (1990), and Sanchez-Robles (1998) which underline the relationship between macroeconomic instability and economic growth. On the same side, many empirical studies have found that there are several potential determinants of macroeconomic instability and cause constraints to economic growth, for instance, the exchange rate, inflation rate, unemployment, interest rate, trade deficit, external debt, and the budget deficit (Liew et al.2018). Chenaf and Rougier (2016) and Albulescu and Ianc (2016) investigated the effect of macroeconomic instability on FDI flows. These studies proved that macroeconomic stability is an important condition to attract foreign direct investment.

Other studies tried to measure the macroeconomics instability using macroeconomic variables such as inflation, public deficit, and the unemployment rate to include in the equation as proxies macroeconomic instability. On the other hand, some studies attempted to construct a macroeconomic instability index using a single variable. For example, Fosu (1992) Using a single indicator for macroeconomic instability, examines the role of export instability in the economic growth of African countries. Ghura and Grennes (1993) show that the real exchange rate (RER) misalignment constitutes to an adverse effect relationship with economic growth. While Ramey and Ramey (1995) declare that the inflation rate contributed to macroeconomic instability and contributes to a negative effect on the growth, especially for the poor class of the economy. Instead of using a single variable to investigate macroeconomic stability, other empirical studies used a variety of macroeconomic variables, such as Bleaney (1996), Sanchez-Robles (1998), Ahangari et al. (2014), and Liew et al. (2018). In addition, to show the relationship between economic stability and macroeconomic variables such as inflation, unemployment, and public deficit, empirical studies have used Various methodologies, based on the used the Cobb–Douglas production function. Other studies that have applied the ARDL approach such as, Albulescu and Ianc (2016), and Liew et al. (2018). To investigate a relationship between macroeconomic stability and economic variables, several empirical studies conducted on many economies, both individually or group of countries. Ahangari et al. (2014) , and Ismihan el al. (2005) study Iranian case applying times series data. other works apply panel data like, Chenaf and Rougier (2016) on countries in the Middle East and North Africa (MENA) region and VO et al. (2019) on 22 emerging countries, also, Hurduzeu and Lazăr (2015) in five Southern Euro Area countries (Portugal, Ireland, Italy, Greece, and Spain). In the context of the previous presentation of theoretical and experimental literature which focused on the mutual influence between many variables of macroeconomic and macroeconomic (in)stability, this study seeks to measure the macroeconomic (in)stability index (MII) and investigate the most important external determinants using panel data from four countries in North Africa (Algeria, Egypt, Morocco, and Tunisia) covering the period from 1999 to 2018.

2. MEASURE OF MACROECONOMIC (IN)STABILITY: THEORETICAL FRAMEWORK

There are various ways to measure macroeconomic stability. Literatures, in the field of decentralization, mostly use price stability, measured by inflation, as proxy for macroeconomic stability (King and Ma, 2001; Neyapti, 2004; Martinez- Vazquez and McNab, 2006). Three approaches were identified, in the Empirical Literature survey, on the measure of macroeconomic (in)stability, The first approach, is based on Misery Index (MI) as a measure of economic well-being for a specified economy and study the macroeconomic instability (Layton, 1992). The second approach interest on the level of macroeconomic stability basing on a Fuzzy Analysis of Macroeconomic Stability (Imanov et al. 2018) and by using thresholds recommended by Maastricht treatment and Alert Mechanism European Commission for indicators of macroeconomic stability (Baun, 2018). This approach calculate Aggregate Index of Macroeconomic Stability (AIMS) for each year, intuitionistic linguistic weighted average (ILWA) formula developed by Wang and Li (2010). The third approach measuring both stability and instability by using macroeconomic instability index (MII) calculated by using four principals' macroeconomic variables. This index inspired from Nicholas Kaldor's (1960) "magic square" which interested in four specific macroeconomic targets (the

growth of real output, full employment, price stability, and external balance) to achieve the general equilibrium (Picek, 2017). In this work and within this approach, we will adjust the MII to be calculate by adding a fifth variable, so that we move from "Kaldor's square" to a pentagon shape.

2.1 Misery Index

Many studies suggest that the most suitable proxy for measuring macroeconomic (in)stability is the combination of unemployment and inflation (Martinez-Vazquez and McNab, 2006); Iqbal and Nawaz, 2010). This measure of economic well-being for a specified economy called the Misery Index (MI). It calculated by adding the inflation rate to the unemployment rate. A decreasing index means a well-being economic climate for the economy in question, and an increasing unemployment rate and relatively high inflation have a negative impact on economic growth. Other studies used the "*optimal levels of inflation and unemployment*" (Golden et al. 1987, 1990; Yang, 1992, Layton, 1992). But this static approach was not convincing to be adopted in contemporary research. Cohen et al. (2014) develop a dynamic approach to decompose the misery index using two basic relations of modern macroeconomics: the expectations-augmented Phillips curve and Okun's law. The recent studies focused on macroeconomic instability added some variables, others then unemployment and inflation to established Misery Index (Cohen et al. 2014).

2.2 Aggregate Index of Macroeconomic Stability (AIMS)

The World Bank describes macroeconomic stability as follows: When inflation is low and predictable, real interest rates are appropriate, real exchange rates are competitive and predictable, public sector savings rates correspond to program resource mobilization requirements, and balance Status of payments is considered Variable (World Bank, 1993). According to the Maastricht Treaty (Baun, 2018; Imanov et al. 2018), macroeconomic stability is measured through five variables: (i) Low and stable inflation (the Maastricht criteria capped at 3%); (ii) Low long-term interest rate (the Maastricht criteria restricted to the range of 9%); (iii) Low debt to Gross Domestic Product ratio (the Maastricht criteria capped at 60% of GDP); (iv) Low deficit (the Maastricht criteria capped at 3% of GDP); and (v) Monetary stability (the Maastricht criteria permitted fluctuation of at most 2.5%).

2.3 The macroeconomic (in)stability index (MII)

The Macroeconomic Instability Index (MII) has undergone major changes during the economic course of the previous decades, a composite index that calculated by summing the standard value of four macroeconomic variables such as inflation, the budget deficit rate to GDP, the ratio of external debt to GDP and the exchange rate. The method for calculating the Macroeconomic Instability Index (MII) based on the methodology used in calculating the Human Development Index (HDI) and the Human Development Index of the United Nations Development Program (UNDP). Therefore, it seems unreasonable to add their values or take their simple mean in order to obtain a composite index, because the four indicators are not in the same units and most importantly they have different ranges, and they also have different minimum and maximum limits. The HDI methodology solves relatively these problems. This methodology was used due to the need to normalize the parameters of the macroeconomic instability index containing different units of measurement and the range of fluctuations. Therefore, MII is created in two steps using this methodology. In the first step, four sub-indices are created based on the general formula followed by equation below:

$$Z_t = \frac{X_t - X_{Min}}{X_{Max} - X_{Min}}$$

Where, Zt refers to the normalized index value of variable X, i.e. macroeconomic instability indicator X, in year t, Xt refers to the actual value of indicator X in year t, and X_{Min} (X_{Max}) refers to the minimum respectively (maximum) value of indicator X over the whole period under consideration (1990-2017). Note

that in line with their construction, all sub-indices have common ranges, i.e. they are bounded between 0 and 1. In the second and the final step, MII is constructed by taking simple average of the five sub-indices obtained as above. The value of the index is in between zero and one: if the value of the indicator (MII) closer to one (1) means high macroeconomic instability, while if the value of the indicator (MII) approaches to zero, there is total stability.

3. EMPIRICAL STUDY: METHODOLOGY AND FORMWORK

3.1 Measuring Macroeconomic Instability Index (MII)

In order to calculate the "Macroeconomics Instability Index", most economists introduce a weight average of the four variables; inflation index, budget deficit to GDP ratio, foreign debt to GDP ratio and the exchange rate changes (Ismihan et al., 2005; Ahangari et al. 2014). The original idea in the present study based on the use of five macroeconomic variables to calculate the MII index for North African countries, unlike most previous studies, which relied only on four variables to build the MII index. It used variables include inflation rate (INF), change in real exchange rate (EXR), budget deficit rate to the gross domestic product (BD) and change in exchange relationship (*TOT*), and unemployment rate (*UMR*). This index has been defined as total weight of inflation rate, real exchange rate fluctuations, change in the budget deficit, fluctuations in the exchange relationship and unemployment rate. It should be noted that weight of each variable is varied equivalent to its standard deviation (SD).

$$MII_t = w_1\left(\frac{INF - \min INF}{\max INF - \min INF}\right) + w_2\left(\frac{EXR_t - \min EXR}{\max EXR - \min EXR}\right) + w_3\left(\frac{BD_t - \min BD}{\max BD - \min BD}\right) + w_4\left(\frac{TOT_t - \min TOT}{\max TOT - \min TOT}\right) + w_5\left(\frac{UMR_t - \min UMR}{UMR}\right)$$

We rewrite the MII for every country in above equation

$$MII_{it} = \sum_{j=1}^{5} w_{ij}\left(\frac{X_{itj} - \min X_{ij}}{\max X_{ij} - \min X_{ij}}\right)$$

Which can be written,

Where $\sum_{j=1}^{5} w_{ij} = 1$ for each county

$$MII_{it} = \sum_{j=1}^{5} w_{ij} Z_{itj}$$

Where

$$Z_{itj} = \left(\frac{X_{itj} - \min X_{itj}}{\max X_{itj} - \min X_{itj}}\right)$$

The weighted weight w_{ij} is calculated by using the standard deviation of the variable (j) for all the period (1999-2018) for each country (i) as follow;

$$w_{ij} = \frac{z_{itj}}{\sum_{i=1,j=1}^{i=4,j=5} \sigma_{Z.ij}}$$

X_{tij}= the normalized value of each variable in each country in the period. Noting that i, t and j replace respectively; countries (Algeria, Egypt, Morocco, Tunisia), time periods (1999 - 2018), and variables (EXR, INF, UNRA, DBT, EXD).The value of the index is in between zero and one, 1 means high macroeconomic instability and 0 means stability. Table 1 shows the economic instability index (MII) calculated for Algeria, Egypt, Morocco, and Tunisia during the period 1999-2018.

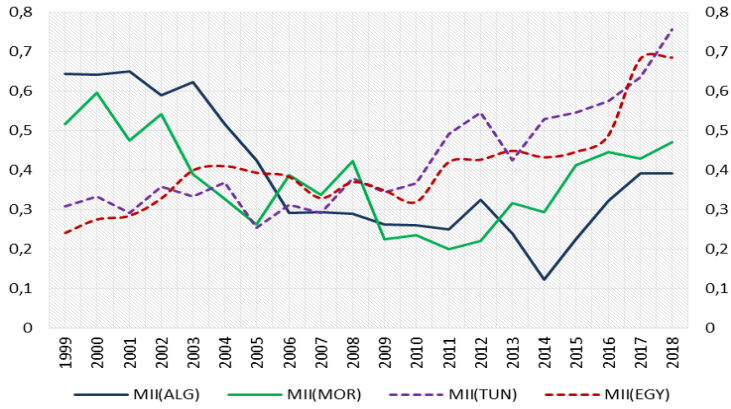
Table 1. The Macroeconomic Instability Index

years	$MII_{ALGERIA}$	MII_{EGYPT}	$MII_{MOROCCO}$	$MII_{TUNISIA}$
1999	0.644781	0.241341	0.517017	0.309476
2000	0.642274	0.275479	0.5963	0.333444
2001	0.64981	0.284446	0.476358	0.291345
2002	0.590861	0.328098	0.542553	0.358362

2003	0.623405	0.399548	0.390884	0.333264
2004	0.516827	0.410615	0.327215	0.369073
2005	0.424366	0.393607	0.262316	0.253514
2006	0.290934	0.383774	0.388378	0.312149
2007	0.294811	0.329465	0.337265	0.290813
2008	0.289457	0.369933	0.422468	0.379692
2009	0.263148	0.348682	0.224781	0.343185
2010	0.259879	0.320308	0.234719	0.366978
2011	0.250479	0.420194	0.199901	0.491361
2012	0.325434	0.426861	0.22107	0.546078
2013	0.238901	0.449415	0.315984	0.424778
2014	0.123748	0.432934	0.294884	0.530095
2015	0.22598	0.446909	0.413342	0.546413
2016	0.323153	0.487562	0.446634	0.574847
2017	0.392122	0.681742	0.429572	0.635418
2018	0.392851	0.685884	0.471468	0.756039

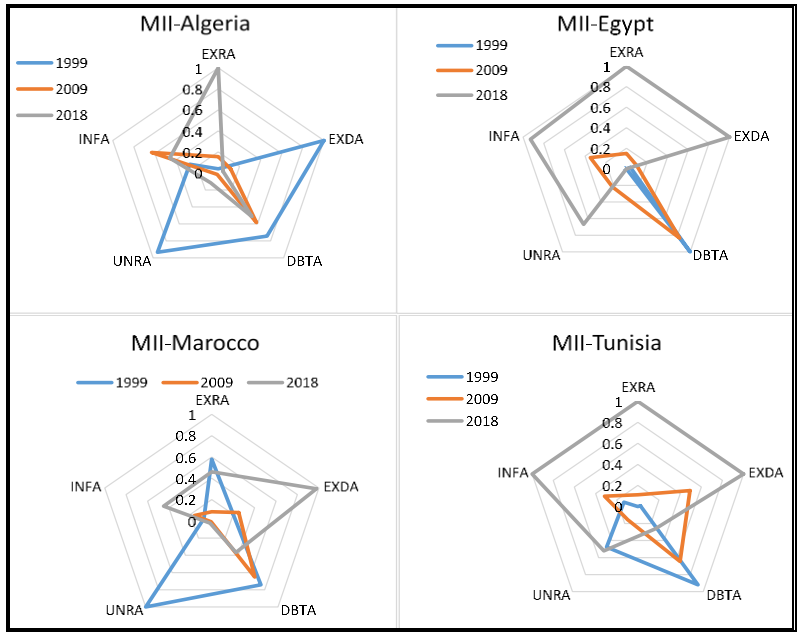
Source: authors' calculations, data from WDI-World Bank Database

The presentation of table 1 in graph1 shows more clearly to illustrate the variability of MII during the studied period and its variations from one country to another.



Graph 1. MII fluctuation curve by countries

Source: Authors' elaboration, from the outputs Eviews.



Graph 2. Macroeconomic Stability Pentagons in North African Countries, during 1999-2018

Source: Authors' elaboration, data from WDI-World Bank Database.

As observed from the graph1, both Morocco and Algeria were suffering from instability at the beginning of the studied period compared to Egypt and Tunisia. While, at the end of the study period, and under the influence of the Arab Spring revolutions, Morocco and Algeria became more economically stable than Egypt and Tunisia. Through using the pentagon graph, which represents the MII components, it provides a deeper reading of the reasons for economic instability in each country. The pentagon diagram, presented in graph 2, shows the 5 MII compounds for three different years (1999, 2009 and 2018). In 1999, it is clear from the drawing that the main component of the Macroeconomic Instability Index in the four countries, especially in Egypt and Tunisia, was the budget deficit. This result is consistent with the financial situation of these countries achieving a permanent deficit in their budget. Also, the success of the economic reform programs implemented since the beginning of the nineties to reduce inflation and achieving stability in exchange rates. In 2009, it is noted that the Macroeconomic Instability Index in studied countries is due to the budget deficit and inflation. Note that, external debt represents a third important determinant of macroeconomic instability in the case of Morocco and Tunisia. This result shows the repercussions of the global financial crisis 2008 and its negative effects on the economies of the countries of the world from high inflation rates and an increase in the budget deficit that may cause some countries to resort to external debt as in Tunisia and Morocco. Finally, in 2018, the drawing shows that the Macroeconomic Instability Index in North African countries is due to several variables and different from one country to another, but the exchange rate, inflation, and external debt are the most important factors in instability. The effects and repercussions of the Arab Spring revolutions are obvious in the economies of North African countries from a decline in the components of the Macroeconomic Instability Index (MII).

3.2 Estimation of the determinant of MII

This part of the study is interested to analysis the determinants of economic stability using macroeconomics panel data covering the period 1999 – 2018 and a cross-section of four North African countries (Algeria, Egypt, Morocco and Tunisia). The data used are obtained from the World Bank and the central banks of the North African countries' interested by this study. We shall set up a model of the North African macroeconomics system so as to discuss the influence of same macroeconomic variables supposed as a determinants of macroeconomic instability. There are many studies, which attempt to find the main determinant of the macroeconomic stability (Ismihan et al. 2005; Ahangari et al., 2014; Dadgar and Nazari, 2018). To determine which variables have an effect on the economic stability by using the following model:

$$\mathrm{MII}_{it} = \propto_i + \beta_{\mathrm{it}} \sum_{j=1}^{k} X_{jit} + \mu_{it}$$

Where, MII_{it} is the proxy of macroeconomic Instability index, it is the endogenous variable. X_{jit} represents the *k* exogenous variables such as: MS money supply; EX, export(% of GDP); IM, import (% of GDP); INV, GFCF(% of GDP); i =country, t= perod, and μ_{it} = stochastic error term.

The choice of the explained explanatory variables is because of two reasons: The first reason is to search for external variables that affect macroeconomic stability that not included in the MII calculation, and the second reason is due to the availability of data for countries and the period under study. To analyze the determinants of economic stability, many methods have been suggested in the econometric literature for investigating the long-run equilibrium relationship among variables. To choose the suitable methods of estimation, at the first, we do a unit root test for all variables to choose the suitable model for estimation based on the variable's integration degrees. Starting with an overview description of the variables used in the study showed in table 2. In order to avoid spurious regression problems it is necessary to carry out a unit root test of panel data before estimating the relationship between Macroeconomic instability index (MII) and other variables.

Table 2. Descriptive statistics common sample of all variables.

Variables / common sample	MII	MS	IM	EX	INVT
Mean	0.397993	78.54977	36.70316	33.38932	24.90211
Median	0.381733	75.61828	33.35344	34.66622	24.21052
Maximum	0.756039	119.3549	62.04005	55.65827	43.07460
Minimum	0.123748	37.82973	19.90109	10.34546	12.44560
Std. Dev.	0.132839	20.55557	11.54022	10.65901	7.028002
Skewness	0.628228	0.471667	0.378533	-0.187618	0.588809
Kurtosis	2.818860	2.446395	1.945269	2.226596	3.015453
Jarque-Bera	5.371649	3.987857	5.618687	2.463185	4.623405
Probability	0.068165	0.136159	0.060245	0.291828	0.099092
Sum	31.83945	6283.981	2936.253	2671.146	1992.169
Sum Sq. Dev.	1.394050	33379.98	10520.96	8975.540	3902.032
Observations	80	80	80	80	80

Source: Authors' calculations based on the World Bank data

3.2.1 Panel Unit root test

Recent literature suggests that panel-based unit root tests have higher power than unit root tests based on individual time series. They are similar, but not identical, to unit root tests carried out on a time series. There are five methods to conduct a panel data unit root test divided on two approaches based on the assumption of autoregressive coefficients (ρ_i) in AR(1) process for panel data given by following equation:

$$y_{it} = \rho_i \, y_{i,t-1} + \delta_i X_{it} + \epsilon_{it}$$

Where, I = 1,2 ...,N cross-section , t = 1, 2 ...T periods

The X_{it} represent the exogenous variables in the model, including any fixed effects or individual trends, ρ_i are the autoregressive coefficients, and the errors ϵ_{it} are assumed to be mutually independent idiosyncratic disturbance. The first approach, assume that there is a common unit root process so that (ρ_i) is identical across cross-sections. Levin, Lin and Chu (2002), Breitung (2000) and Hadri (2000) tests all employ this assumption. From this approach we use LLC test in our work. This test is theoretical written as.

$$\Delta y_{it} = \alpha \, y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{ij} \, \Delta y_{i,t-j} + \delta X'_{it} + \epsilon_{it}$$

Where, we assume a common $\alpha = \rho - 1$ but allow the lag order for the difference terms, p_i, to common across cross-sections. The null and alternative hypotheses for the tests may be written as:

$$H_0: \alpha = 0$$

$$H_1: \alpha < 0$$

Under the null hypothesis $\alpha = 0$ mean $\rho = 1$, there is a unit root, while under the alternative, there is no unit root. The second approach, allow for individual unit root processes so that ($\alpha_i = \rho_i - 1$) may vary across cross-sections. IPS test (Im et al., 2003), Fisher-type tests using ADF and PP tests (Maddala and Wu 1999). From this approach we use IPS test which theoretical presented by:

$$\Delta y_{it} = \alpha_i \, y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{ij} \, \Delta y_{i,t-j} + \delta X'_{it} + \epsilon_{it}$$

$$H_0: \alpha_i = 0$$
$$H_1: \alpha_i < 0$$

Under the null hypothesis $\alpha_i = 0$ mean $\rho_i = 1$, there is a unit root, while under the alternative, there is no unit root. We choose IPS and LLC tests because they are a recent tests and more used in the field.

Table 3. Panel Unit Root Tests, Stationarity of the variables

Variables	*Type of test*	*In Level*				*In 1st Diff*				*Stationary*
		intercept		*Intercept andtrend*		*intercept*		*Intercept andtrend*		
		Statistic	*Prob.*	*Statistic*	*Prob.*	*Statistic*	*Prob.*	*Statistic*	*Prob.*	
MII	**LLC**	0.3339	0.6308	1.1861	0.8822	-7.9475	0.0000	-8.6233	0.0000	**I(1)**
	IPS	1.3199	0.9066	2.0396	0.9793	-6.7830	0.0000	-6.5344	0.0000	**I(1)**
MS	**LLC**	-2.1851	0.0144	-0.3551	0.3613	-2.7884	0.0026	-2.0257	0.0214	**I(1)**
	IPS	-1.0721	0.1418	-2.2091	0.0136	-4.2337	0.0000	-3.0204	0.0013	**I(1)**
EX	**LLC**	-0.6863	0.2463	-1.6439	0.0501	-7.7885	0.0000	-6.9173	0.0000	**I(1)**
	IPS	-0.1433	0.4430	-0.7982	0.2124	-6.3625	0.0000	-4.8338	0.0000	**I(1)**
IM	**LLC**	-1.3993	0.0809	-1.5312	0.0629	-6.5791	0.0000	-5.5777	0.0000	**I(1)**
	IPS	0.0128	0.5051	-1.2609	0.1037	-5.7599	0.0000	-4.2042	0.0000	**I(1)**
INVT	**LLC**	-0.3555	0.3611	1.4845	0.9310	-8.5046	0.0000	-6.3424	0.0000	**I(1)**
	IPS	-1.7032	0.443	-3.6443	0.0001	-10.3498	0.0000	-9.1210	0.0000	**I(1)**

Note: Numbers within the parenthesis indicate the p-value, if plus-value more than 5% the variable is stationary. I(0) mean integrated in the level, I(1) integrated in the first level.
The significance acquired at 1% or 5%.

Source: Authors' elaboration from the outputs Eviews.

According to the panel unit test analysis in table 3, all variables are integrated in order one I(1), meaning that there are not stationary in level, there is stationary in first difference. In this scenario, it is suitable to establish a long-run relationship by performing a panel cointegration test to explore the long run link between the endogenous variable Y, and the exogenous variables. Before this step, it is methodologically to determine the periods of lags to perform the cointegration test. Table 4 shows the results of the different criteria of lag length order selection. The optimum lag for the model selected by the criterion AIC is 1 as indicated by asterisk.

Table 4: Cointegration Lag selection

VAR Lag Order Selection Criteria
Endogenous variables: MII MS EX IM INVT

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-846.1448	NA	1442839.	28.37149	28.54602	28.43976
1	**-507.3014**	**609.9181**	**41.43043***	**17.91005***	**18.95722***	**18.31965***
2	-486.7029	33.64421	48.82993	18.05676	19.97658	18.80771
3	-457.5036	42.82572*	44.40945	17.91679	20.70925	19.00907
4	-435.1723	29.03064	53.02672	18.00574	21.67085	19.43937
5	-409.5176	29.07532	60.40886	17.98392	22.52167	19.75888

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

Source: Authors' elaboration from, the outputs eviews.

3.2.2 Cointegration relationship

Two types of panel co-integration tests are used in this study; the Kao (1999) test and Johansen Fisher Panel Cointegration Test (Maddala and Wu, 1999). The results got by these two tests (p-value<0.05) confirmed the existence of a dull long run association relationship. In addition, Johansen Fisher panel Cointegration Test contains the results of two tests: Trace and Maximum Eigenvalue. The null hypothesis of no cointegrating (none), (at most 1) and (at most 2) vector is rejected because the calculated value is greater than the scheduled value estimated at a 5% level. Thus, there is a cointegration relationship regarding the third hypothesis (at most 2).

To analyze the determinants of economic stability, many methods have been suggested in the econometric literature for investigating the long-run equilibrium relationship among variables.

To investigate the relationship between macroeconomic (in) stability index (*MII*) and some selected exogenous variable: money supply (*MS*), investment (*INVT*), export (*EX*) and import (*IM*) we use the following regression form:

$$MII_{it} = \alpha_0 + \alpha_1 MS_{it} + \alpha_2 EX_{it} + \alpha_3 IM_{it} + \alpha_4 INVT_{it} + \mu_{it}$$

Through estimating this model, The study investigate some of the determinants of macroeconomic (in)stability. According to the value of the MII that ranges from zero to one: where the value of the MII approaches to zero, indicating an increase in macroeconomic stability, while if the MII approaches to one, it means an increase in the state of economic instability. Accordingly, the study seeks to examine the hypothesis that economic stability is negatively affected by money supply and import value (positive sign between MII and the money supply and imports) and is positively affected by increased exports and investment (negative sign between MII and exports and investment). Table 6 summarizes the estimated result provided by the appropriate estimation method.

Table 5: Panel cointegration tests

a) Kao Residual Cointegration Test Series: MII MS EX IM INVT			
Null Hypothesis: No cointegration	*t-Statistic*	*Prob.*	
ADF	*-1.739979*	*0.0409*	
Residual variance		0.004499	
HAC variance		0.003916	

b) Johansen Fisher Panel Cointegration Test Series: MII MS EX IM INVT				
Hypothesized No. of CE(s)	*Fisher Stat.**			
	(from trace test)	*Prob.*	*(from max-eigen test)*	*Prob.*
None	115.6	0.0000	72.58	0.0000
At most 1	58.38	0.0000	47.56	0.0000
At most 2	20.27	0.0093	16.12	0.0407
At most 3	10.74	0.2169	8.521	0.3843
At most 4	14.18	0.0771	14.18	0.0771
* Probabilities are computed using asymptotic Chi-square distribution.				

Source: Authors' elaboration from, the outputs eviews.

Table 6. Multiple linear regression model for evaluation of macroeconomic (in)stability in selected four north African countries in 1999-2018 (panel method)

MII is the endogenous variable

Models	*(1) PFGLS (Cross-section fixed effects)*		*(2) Method: PFGLS (Period random effects)*		*(3) Panel Fully Modified Least Squares (FMOLS)*		*(4) Panel Dynamic Least Squares (DOLS)*	
Exogenous Variables	*Coefficient (t-Statistic)*	*Prob.*	*Coefficient (t-Statistic)*	*Prob.*	*Coefficient (t-Statistic)*	*Prob.*	*Coefficient (t-Statistic)*	*Prob.*
Intercept (c)	1.1656*** (13.2659)	0.0000	1.1088*** (12.5892)	0.0000				
MS (moneysupply)	-0.0027** (-2.36824)	0.0206	-0.0036*** (-3.03231)	0.0034	-0.0032** (-2.49373)	0.0151	0.00189 (0.30392)	0.7664
EX (Export)	-0.0136*** (-6.59054)	0.0000	-0.0116*** (-5.71622)	0.0000	-0.0129*** (-6.76008)	0.0000	-0.0157*** (-3.77141)	0.0027
IM (Import)	0.0195*** (6.63103)	0.0000	0.0203*** (9.80916)	0.0000	0.02012*** (6.57001)	0.0000	0.006991 (0.43437)	0.6717
Invt (GFCF)	-0.0327*** (-20.1105)	0.0000	-0.0315*** (-19.3568)	0.0000	-0.0328*** (-11.0752)	0.0000	-0.0300*** (-3.41938)	0.0051
Nb of Obs	80		80		76		68	
R2	0.717919		0.683865		0.609068		0.934113	
F-statistic (p-value)	26.17798	(0.0000)	22.25014	(0.0000)				
DW	0.884377		0.893495					
Redundant FE Tests (p-value)	41.636835	(0.0000)						
Hausman Test(p-value)			2.180865	(0.7025)				

*Note: Robust standard errors are shown below the coefficient estimate with ***, ** denoting significance at the 1 and 5% significance levels, respectively.*
Source: Authors' elaboration from, the outputs eviews.

3.3 Results interpretations

From the table 5, it appears four estimated models (1), (2), (3), and (4). They summarized the different results of regressions given by the models. The appropriation of the models passes through a testing process known in the methodology of econometric analysis (stationarity and cointegration tests). In the four estimated models, MII considered as the dependent variable. Money supply, exports, imports, and domestic investment were independent variables. The second aim of this study is to investigate the external determinants of MII. Model (1) (Panel EGLS - Cross-section fixed effects) that takes into account the fixed effects between countries, while, Model (2) (Panel EGLS - Period random effects) takes random effects between years. In both two methods the estimation result improve that, Money supply, exports, and investments have a highly significant statistical relationship (p-value < 0.05) with a negative sign to the MII. So these variables decrease the level of macroeconomic instability. On the other side, imports have a highly significant statistical relationship with a positive sign, so this variable positively affect MII, which means an increase in the level of macroeconomic instability.

Model (3) (Panel Fully Modified Least Squares -FMOLS) and model (4) (Panel Dynamic Least Squares -DOLS) illustrates the estimation of long-term cointegration relationships. They estimate the long-run impact of money supply (MS), export (EX), import (IM) and investment (GFCF) on the macroeconomic instability of four North African countries. . The estimation result of model (3) confirm the consistent results looked in models (1) and (2), that Money supply, exports, and investments have a highly significant statistical relationship with a negative sign, and imports have a highly significant statistical relationship with a positive sign. Model (4) emphasizes the results of the previous models regarding the variables of exports and investment. This shows that domestic investment and export have an important effect on the

macroeconomic (in)stability in the four countries studied in this work. But, money supply and imports, they are statistically insignificant.

The results beyond, achieved through the econometric analysis confirm that, North African countries have a strategic location - representing a gate that connects the four continents of Africa, Asia, Europe, and America- It can enhance the trade exchange of these countries. Also, economic diversification, abundant wealth, and skilled labor force are creating opportunities for domestic investment and accumulation of capital formation, contributes to enhancing macroeconomic stability.

CONCLUSIONS

The original idea in the present study based on the use of five principal macroeconomic variables to calculate the MII index for North African countries, unlike most previous studies, which relied only four variables to build the MII index. So, In this work, first, we adjusted measuring method for macroeconomic instability index (MII) by adding a fifth variable to the four variables adopted in the previous economic literature, calculated it in four North African countries (Algeria, Egypt, Morocco, and Tunisia), then calculating it in four North African countries (Algeria, Egypt, Morocco, and Tunisia), second, we examine the main determinants of macroeconomic instability. The stationarity of all variables in the first difference permits us to study the long run associate relationship between MII and the macroeconomic variable proposed as its determent's. The panel cointegration test concludes that there is a significant relationship in favor of the hypothesis that there is a long-run cointegration relationship linking money supply, export, import, domestic investment, and macroeconomic (in)stability.

The findings, obtained by using FGLS and Panel FMOLS and DOLS panel estimations, highlight that, money supply, exports, and investments have a strong significant statistical relationship with a negative sign to the MII. While, import has strong significant a positive effect on MII. According to the results achieved through standard economic analysis, along with some economic characteristics of North African countries, trade, investment and monetary policy are among the important factors in achieving macroeconomic stability. Therefore, economic policymakers in North African countries must work to enhance foreign trade, benefiting from the geographical location and based on the ingredients had by those countries, while identifying factors that promote exports.

REFERENCES

Acemoglu, D., Angrist, J.D. (2001), "Consequences of employment protection? The case of the Americans with Disabilities Act", *Journal of Political Economy*, Vol. 109, No. 5, pp. 915-957.

Acemoglu, D., Johnson, S., Robinson, J., Thaicharoen, Y. (2003), "Institutional causes, macroeconomic symptoms: volatility, crises and growth", *Journal of Monetary Economics*, Vol. 50, No. 1, pp. 49-123.

Ahangari, A., Arman, A., Saki, A. (2014), "The estimation of Iran's macroeconomics instability index", *Management Science Letters*, Vol. 4, No. 5, pp. 871-882.

Albulescu, C.T., Ianc, N.B. (2016), "Fiscal policy, FDI and macroeconomic stabilization", *Review of Economic and Business Studies*, Vol. 9, No. 2, pp. 131-146.

Barro, R. J., Sala-i-Martin, X. (2003), *Economic Growth*, Vol. 1, MIT Press Books.

Baun, M. J. (2018), *An imperfect Union: The Maastricht Treaty and the new politics of European integration*, Routledge.

Bleaney, M. F. (1996), "Macroeconomic stability, investment and growth in developing countries", *Journal of Development Economics*, Vol. 48, No. 2, pp. 461-477.

Chenaf-Nicet, D., Rougier, E. (2016), "The effect of macroeconomic instability on FDI flows: A gravity estimation of the impact of regional integration in the case of Euro-Mediterranean agreements", *International Economics*, Vol. 145, pp. 66-91.

Cohen, I. K., Ferretti, F., McIntosh, B. (2014), "Decomposing the misery index: A dynamic approach", *Cogent Economics and Finance*, Vol. 2, No. 1, pp. 991089.

Dadgar, Y., Nazari, R. (2018), "The impact of economic growth and good governance on misery index in Iranian economy", *European Journal of Law and Economics*, Vol. 45, No. 1, pp. 175-193.
Dornbusch, R., Edwards, S. (1990), "Macroeconomic populism", *Journal of Development Econo-mics*, Vol. 32, No. 2, pp. 247-277.
Easterly, W., Rebelo, S. (1993), "Fiscal policy and economic growth: An empirical analysis", *Journal of Monetary Economics*, Vol. 32, pp. 417-458.
Fischer, S. (1993), "The role of macroeconomic factors in growth", *Journal of Monetary Economics*, Vol. 32, pp. 485-512.
Fosu, A.K. (1992), "Effect of export instability on economic growth in Africa", *The Journal of Developing Areas*, Vol. 26, No. 3, pp. 323 332.
Frenkel, J.A., Khan, M.S. (1990), "Adjustment policies and economic development", *American Joiurnal of Agricultural Economics*, Vol. 72, pp. 815-820.
Furman, J., Stiglitz, J.E., Bosworth, B.P., Radelet, S. (1998), "Economic crises: evidence and insights from East Asia", *Brookings Papers on Economic Activity*, Vol. 2, pp. 1-135.
Ghura, D., Grennes, T.J. (1993), "The real exchange rate and macroeconomic performance in Sub Saharan Africa", *Journal of Development Economics*, Vol. 42, pp. 155-174.
Golden, J.M., Orescovich, R., Ostafin, D. (1987), "Optimality on the short-run Phillips curve: A misery index criterion. A note", *The American Economist*, Vol. 31, No. 2, pp. 72.
Golden, J. M., Orescovich, R., Ostafin, D. (1990), "Optimality on the short-run Phillips curve: A misery index criterion. A reply", *The American Economist*, Vol. 34, pp. 92.
Hausmann, R., Pritchett, L., Rodrik, D. (2005), "Growth accelerations", *Journal of Economic Growth*, Vol. 10, No. 4, pp. 303-329.
Hurduzeu, G., Lazăr, M.I. (2015), "An assessment of economic stability under the new European economic governance", *Management Dynamics in the Knowledge Economy*, Vol. 3, No. 2, pp. 301.
Im, K.S., Pesaran, M.H., Shin, Y. (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics*, Vol. 115, No. 1, pp. 53-74.
Imanov, G., Hasanli, Y., Murtuzaeva, M. (2018), "Fuzzy Analysis of Macroeconomic Stability" in *International Conference on Theory and Applications of Fuzzy Systems and Soft Computing*, pp. 223-229, Springer, Cham.
Iqbal, N., Nawaz, S. (2010), "Fiscal decentralization and macroeconomic stability: Theory and evidence from Pakistan", *MPRA Paper*, No. 27184.
Ismihan, M., Metin-Ozcan, K., Tansel, A. (2005), "The role of macroeconomic instability in public and private capital accumulation and growth: the case of Turkey 1963–1999", *Applied Economics*, Vol. 37, No. 2, pp. 239-251.
Kaldor, N. (1960), "Essays on Economic Stability and Growth", chapter 1, *Speculation and economic stability*, pp. 17-58.
Kao, C. (1999), "Spurious regression and residual-based tests for cointegration in panel data", *Journal of Econometrics*, Vol. 90, No. 1, pp. 1-44.
King, D., Ma, Y. (2001), "Fiscal decentralization, central bank independence, and inflation", *Economics Letters*, Vol. 72, No. 1, pp. 95-98.
Layton, A. P. (1992), "An Estimated Australian Macroeconomic Misery Index", *Economic Record*, Vol. 68, No. 2, pp. 118-124.
Levin, A., Lin, C. F., Chu, C. S. J. (2002), "Unit root tests in panel data: asymptotic and finite-sample properties", *Journal of Econometrics*, Vol. 108, No. 1, pp. 1-24.
Liew, V.K.S. et al. (2018), "Macroeconomic Instability Index and Malaysia Economic Performance", *International Business Research*, Vol. 11, No. 3, pp. 179-185.
Maddala, G.S., Wu, S. (1999), "A comparative study of unit root tests with panel data and a new simple test", *Oxford Bulletin of Economics and Statistics*, Vol. 61(S1), pp. 631-652.
Martinez-Vazquez, J., Macnab, R.M. (2006), "Fiscal Decentralization, Macrostability and Growth, Hacienda Pública Española", *Revista de Economía Pública*, Vol. 179, No. 4, pp. 25-49
Montiel, P., Servén, L. (2006), "Macroeconomic stability in developing countries: How much is enough?", *The World Bank Research Observer*, Vol. 21, No. 2, pp. 151-178.
Neyapti, B. (2004), „Fiscal decentralization, central bank independence and inflation: a panel investigation", *Economics Letters*, Vol. 82, No. 2, pp. 227-230.

Picek, O. (2017), “The Magic Square of Economic Policy measured by a Macroeconomic Performance Index”, *The New School for Social Research Working Paper*, No. 2, pp. 1-32.
Ramey, G., Ramey, A. (1995), “Cross country evidence on the link between volatility and growth”, *The American Economic Review*, Vol. 85, No. 5, pp.1138-1151.
Sanchez-Robles, B. (1998), “Macroeconomic stability and economic growth: the case of Spain”, *Applied Economics Letter*s, Vol. 5, No. 9, pp. 587-591.
Stiglitz, J.E. (1999), “Reforming the global economic architecture: lessons from recent crises”, *The Journal of Finance*, Vol. 54, No. 4, pp. 1508-1521.
Wang, J.Q., Li, H.B. (2010), “Multi-criteria decision-making method based on aggregation operators for intuitionistic linguistic fuzzy numbers”, *Control and Decision*, Vol. 25, No. 1, pp. 1571-1574.
World Bank (1993), *The East Asian economic miracle: economic growth and public policy*, http://documents.worldbank.org/curated/en/975081468244550798/Main-report
Yang, B. (1992), “Optimality of the short run Phillips curve revisited”, *The American Economist*, Vol. 36, pp. 89–91.