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Sensitivity of Macroeconomic Variables to the Exchange Rate Fluctuations: Evidence from Transition Countries

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Abstract

This article aims to discuss the effect of the exchange rate variation on short- and long-term fluctuations of different macroeconomic variables. This analysis serves also as a basis for judging the effectiveness of the monetary policy adopted by countries. The focus is mainly on countries in economic transition in the MENA zone (Tunisia, Morocco, Egypt, and Turkey). To achieve economic stability, these countries are faced with a particular situation following the volatility of their exchange rates. In our study, we use a vector error correction model (VECM) to test the cointegration of macroeconomic variables and to establish a dynamic long- and short-run relationship between them. The systematic vector error correction model (SVECM) is subsequently used to measure the impulsive responses of each variable. The results vary by country, but they all agree that transition countries in the MENA region are not adapted to deal with exchange rate shocks. This is why they have not benefited well from the devaluation of their national currency. Even though this exchange rate fluctuation may have a favorable effect in the short term, in the long term its consequences on basic macroeconomic variables are catastrophic, which automatically leads to the deterioration of economic growth.

Keywords: Exchange rate regimes, macroeconomic variables, countries in transition, currency crises, VECM. SVECM.

JEL: G01, G15, G32, F41, F31, F36

1. Introduction

The world economy has experienced a bulk of positive and negative shocks in exchange rates over the years. Such shocks have affected the macroeconomic variables in the countries of the world and have challenged the economies of these countries and have led them to take different measures to protect themselves against the devastative effects of these shocks. However, some researchers, Friedman (1953) the pioneer in this subject, have presented it as an economic troublemaker. Others have described it by market dynamics.

Dornbusch (1976) showed that this indicator is volatile due to the existence of actors with different objectives and expectations. Several theories highlight the exchange rate. According to Friedman (1953), there is a causal relationship between

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exchange rate fluctuation and other variables. This relationship is specific during periods of economic transition. In the literature, countries in transition include mainly Latin America and Eastern Europe. To achieve economic stability and make the transition to a market economy, these countries faced a particular situation relating to the chosen of exchange rate regime. As a result, the exchange rate in these countries has become increasingly volatile. This volatility is considered a very interesting research subject for some economists (Arize, et al. (2008), Egert, et al. (2008), Mejia-Reyes et al. (2010), Ledesma Padilla (2010), Ocampo (2014), Abdurehman and Hacilar (2016), Dal Bianco et al., (2017), …).

Over the past decades, the succession of economic shocks and political problems has made exchange rate fluctuations more intense, particularly for countries in transition (Barguellil et al., (2018), Boroumand et al (2019), Yifan et al (2022), Gürkaynak et al (2023), …). The exchange rate evolution in these countries is largely marked compared to that of others, on a large scale and according to different standards. This fluctuation will have, according to the theoretical and empirical literature, some repercussions on vital indicators reflecting overall economic and financial health. In this context, Hussain et al (2019) discussed the impact of exchange rate changes on economic growth. They were followed by Ilmas et al (2022) who discussed this effect on international trade, through the import and export circuit; and by Özen and al (2020) on inflation, among others, dealing with the same problem for other variables and in different markets.

In this perspective, we will attempt to address the relationship between the exchange rate and other macroeconomic variables in transition countries and the resulting consequences. The objective of this study is therefore to discuss the effect of the variation in the exchange rate on the short- and long-term fluctuations of the different macroeconomic variables. The focus is mainly on countries in the MENA region (Middle East and North Africa) in economic transition after the Arab Spring. Four countries are selected: Tunisia, Egypt, Morocco, and Turkey. The choice of these four economies was motivated by the fact that they share the same transition period and by the substantial drop in their exchange rates.

The rest of the article will be organized as follows. Section 2 will present the literature review discussing the impact of exchange rate fluctuations on the macroeconomic situation during the transition period. Section 3 will present the data. Section 4 will focus on the empirical methodology adopted. Empirical results will be analyzed in section 5 and section 6 is a conclusion.

2. Literature review

The transition of Latin America and Eastern Europe is at the center of interest of researchers during the 1980s. First, Latin America has gone through periods of serious crises. It has gone through a marginal system where there is an intense external debt deficit, an increased participation in global trade flows, domestic violence, an undemocratic politics, and a degraded environment. This period is known as “the lost decade” where there is a pessimistic vision: a homogeny of the United States and an isolation of Latin America.

Likewise, the ex-Soviet bloc (Eastern Europe) went through a transition period. This period is marked by the fall of the Berlin Wall in 1989, the elimination of the communist government because of the revolutions of the population against the authoritarian regime. Trade with the West declined sharply, and new credits became scarce. Several Eastern European regimes were forced to enter extensive refinancing negotiations with Western creditors. These reversals have serious consequences on living standards. During this period, a transition in regimes made the Central European and the United States regimes more authoritarian.

These disruptions are the sources of the crises of the 1980s. Ocampo (2014) noted that during this period, an exchange rate devaluation linked to the balance of payments crisis intensified. The crisis of 1980 is the most intense crisis according to Ocampo (2014). It is characterized by the triplet (a combination of debt crisis, balance of payments and banking crisis) and it includes 18 countries, except Colombia which was not facing a debt crisis. On the other hand, it suffered a disturbance in its balance of payments and a moderate banking crisis.

However, an effect of exchange rate volatility on macroeconomic variables is detected mainly by Baak, (2004), Bahmani-Oskooee and Kutan (2008), Beirne and Bijsterbosch (2011), Korkmaz (2013), Barguellil, et al, (2018), Yifan et al. (2022) and Gürkaynak et al (2023), among others.

In financial and monetary economics, one of the most debated and studied questions concerns the relationship between exchange rates and macroeconomic aggregates, including investment, export, import, GDP growth rate and production (Stavarek, 2013). However, the problem of exchange rate neutrality is linked to the lack of a relationship between exchange rates and macroeconomic variables. But economists have long highlighted the negative impact of a poorly managed exchange rate on economic growth (Rodrik, 2008). This relationship (exchange rate-growth) is supported by international statistical evidence (Johnson, Ostry and Subramanian, 2007; Kocenda, Maurel and Schnabl, 2013; Prasad et al, 2006).

In recent years, researchers have become interested in estimating the impact of exchange rates on domestic processing and production in developing and developed economies. In their research, Bahmani-Oskooee and Mohammadian (2017) quoted some studies on the relationship between exchange rate devaluation and GDP growth. For Eastern Europe and OECD countries, they cited the work of Bahmani-Oskooee and Kutan (2008) and Kalyoncu et al. (2008) respectively. While for the panel of Asian countries, studies were conducted by Bahmani-Oskooee et al. (2002) and Kim and Ying (2007); for Latin American economies by Mejia-Reyes et al. (2010); and for Africa by Bahmani-Oskooee and Gelan (2013). In the case of a single country, Bahmani-Oskooee and Rhee (1997) cover Korea, while Narayan (2007) and Shahbaz et al. (2012) cover Fiji and Boroumand et al (2019) cover the case of Iran. Turkey and Palestine have been studied by Sencicek and Upadhyaya (2010) and Eltalla (2013) respectively.

Addressing this relationship, the IMF found that the variation in exchange rates can have a positive or negative influence on economic growth via trade (Frenkel et al, 2004; Hsing 2004). The J-curve further differentiates the short- and long-term impact of devaluation. The latter will aggravate the trade balance in the short term and improve the situation in the long term and, consequently, overall demand will increase. Indeed, the costs of imported inputs will increase due to the depreciation experienced and the overall supply will be affected. The devaluation will be expansionary if the increase exceeds the decline in aggregate demand, and it is likely to be more restrained in the opposite situation (Bahmani-Oskooee and Mohammadian, 2017).

Few studies have found that the flexible exchange rate responds positively to economic growth. Schnabl (2008) argued that the relationship between exchange rate fluctuation and economic growth is an empirical question. He used a panel of 41 EMU (Economic and Monetary Union) countries over 12 years. An estimate of the exchange rate fluctuation showed the existence of a significant correlation with economic growth. He demonstrated the existence of a positive correlation for countries with a fixed regime. This relationship is maintained since exchange rate stability has a positive effect on international trade, macroeconomic stability and interest rates. Countries, having allowed their currencies to fluctuate via the interest rate channel, have experienced macroeconomic instability. Therefore, he was able to see that the fluctuation of the exchange rate via the trade circuit can influence economic growth. This was confirmed subsequently by Mahmood, Ehsanullah and Habib (2011) and Khan, Sattar and Ur Rehman (2012), who applied the GARCH model to calculate exchange rate volatility. These studies have shown the positive impact of exchange rate fluctuations on GDP, on the growth rate and on economic openness. Also, Aman et al. (2017), using simultaneous equation models on annual data from 1976 to 2010, found that the exchange rate is expansionary. The study claims this positive effect through export channels, investment and FDI.

More recently, new studies have almost confirmed the existence of a negative relationship. Nawaz (2012) asserted the long-term contractionary effect of exchange rates and claims that it is only expansionary in the short term. Hussain et al (2019), by studying the Pakistan market over a long period (1972-2014), verified a co-integration relationship between the exchange rate and economic growth indicators. They also confirmed the existence of an asymmetric impact on GDP and economic growth in addition to an adjustment asymmetry in the short and long term. In the same sequence, another study carried out by Ahmad, Ahmad, and Ali (2013) also applied the simple regression method to confirm the negative effect of the exchange rate on GDP. Cambazoğlu et al (2013) used a VAR model and favored the relationship between the exchange rate and other macroeconomic variables. This model was applied to Turkey and Argentina. It proved the existence of a negative effect on economic growth through two transmission channels. On the one hand, exchange rate uncertainty in a country that adopts the flexible regime can influence trade operations and investment. On the other hand, the impact of exchange rate volatility on economic growth is high in financially open economies. Along the same line of study, Barguellil, et al., (2018) adopted an empirical investigation based on a sample of 45 developing and emerging countries and used the difference and system generalized method of moments estimators. The researchers verified that the volatility of nominal and real exchange rates has a negative impact on economic growth. This negative effect is linked to a flexible exchange rate regime which penalizes international transactions and investment operations. Another factor that explains this relationship is financial openness. Free financial circulation between countries favors exchange rate fluctuations and has this negative impact on economic growth. Also, using a GARCH model, Dal Bianco et al., (2017) estimated the effect of exchange rate fluctuations on FDI for ten countries in Latin America and the Caribbean. They found a significantly negative effect. This fluctuation prevents the entry of multinational companies because it increases the price of uncertainty. Latin American companies are FDI exporters. An exchange rate fluctuation will increase the uncertainty of demand for these companies and reduce their profitability. Furthermore, the fixed regime is more favorable for entering FDI (Dal Bianco et al., 2017).

In another line of study, the exchange rate triggers also trade flows. Unstable exchange rates make it difficult for exporters and importers to determine trade supply and demand prices. This will cause difficulties in planning their activities.

According to Wondemu and Potts (2016), two theoretical frameworks are addressed to explain the interaction between the exchange rate and exports. The first framework postulates that a depreciation of the national currency will have an expansionary effect on trade. Indeed, a depreciated currency makes domestic exports relatively cheaper for foreign buyers, which leads the latter to shift their spending towards the cheapest imports. This is called the traditional approach. In contrast, the second theoretical framework presupposes that currency depreciation could have a contractionary effect on production and employment, particularly in less economically developed countries. The small gains that might have been made through short-term devaluation will be wiped out by inflation in the long term. The results of this study reveal that the real exchange rate has a significant long-run negative relationship with exports. The results obtained are consistent with those according to which the exchange rate has a contractionary effect on trade. Meanwhile, imports have the opposite effect.

This relationship is quite specific for countries that have moved from a fixed regime to a high-amplitude floating regime. According to Arize, et al. (2008), Latin America is among these countries which have adopted the flexible regime. They are based on the work of Arize et al. (2000), who adopted the technique of cointegration and error correction to test the effect of exchange rate fluctuation on exports for thirteen LDCs (least developed countries). Arize, et al. (2008) found an unexpected result. They are the first to prove that exchange rate fluctuations can have a negative effect on export flows. The World Bank defended this result given that the economies of Latin American countries are characterized by middle incomes and subsequently, they have a futures market that helps traders hedge against transaction risk. The work of Arize et al. (2008) is consistent with other work, such as that of Egert, et al., (2008) who studied two groups of Eastern and Central European countries in transition between (1994- 2003). The first group moved from a regime of parity to a regime of freedom. The second has not experienced any change in its exchange rate regime. They found that the exchange rate fluctuation, resulting from the flexible regime, has a negative effect on the export flow. A similar result is found by the research of Fredlina and al (2021) on the Indonesian market and by Dincer and Kindl (2011) on the Turkish market, using a simple linear regression model showing that exchange rates have a negative effect on exports. Confirmed by Ilmas et al (2022) on 5 ASEAN countries namely Indonesia, Singapore, Thailand, Malaysia, and the Philippines and using regression on panel data, they verified the negative relationship between exchange rate and exports of the five countries. Ngondo and Khobai (2018) revealed that floating exchange rate is a double-edged sword as although it allows free mobility of capital and other investment instruments, the negative impact of variability of the exchange rate on exports cancels out the rare advantages obtained.

A second line of study led by Nyeadi, Atiga and Atongenzoya (2014) comes to verify that the exchange rate has no impact on exports of goods and services. A similar result is noted by Nemushungwa, Gyekye and Ocran (2015), who empirically studied through the ARDL limits test, the impact of exchange rate volatility on South African exports. However, by examining the long-term stability of the coefficients and the short-term dynamics, the study results confirmed that exchange rate volatility has an insignificant long-term negative impact on South African exports. The error correction coefficient for the export model is positive and statistically insignificant and therefore does not support the validity of the long-run equilibrium relationship between the variables. Nyahokwe and Ncwadi (2013) used the vector autoregression (VAR) model and the vector error correction model (VECM) to establish the existence of a long-and short-term relationship between exports and the rate of exchange in the same market. The results obtained suggest that there is no statistically significant relationship. The relationship therefore remains ambiguous between South African export flows and the exchange rate.

The third line of study suggests that the exchange rate has a positive and significant effect on exports (Khoironi and Ida Ayu, 2017). Aye, Gupta, Moyo, and Pillay (2015), by applying the Structural Vector Autoregressive (SVAR) and GARCH-in-Mean (GARCH-M) model, arrived at the same conclusion as the latter. More precisely, by studying the impact of exchange rate variations on German exports through DOLS (Dynamic Ordinary Least Squares) estimation, Thorbecke and Kato (2012) were able to observe that exports of consumer goods react more to exchange rate variations as exports of capital goods.

On the other hand, the research carried out by Anshari et al (2017), with the multiple linear regression analysis method, verified that the rate of change has a significant effect on the exports of ASEAN-5 countries. Particularly, this variable has a negative effect on the exports of Indonesia, Malaysia and Singapore and a positive effect on the exports of the Philippines and does not significantly affect Thailand. However, a review of the empirical literature on exports and exchange rates shows clearly that the findings of studies on developed and developing countries are contradictory.

Like the above, some have defended the negative impact of exchange rate devaluation on imports such as Chang et al. (2018) on the Korean market and Yifan et al. (2022) on the Chinese market. Others stipulate the existence of a positive relationship, mainly Habanabakize (2020) on the South African market and Oluyemi and Isaac (2017) on the Nigerian market, among others empirically addressing this issue.

Finally, over the last decade, inflation has emerged as a new component strongly linked to the balance of payments crisis in the Latin American economy. The financial crises faced in (1982-1990) generated a massive devaluation of exchange rates and an increase in inflation rates (Abdurehman and Hacilar, 2016). The problem is more serious when inflation in foreign countries, known as “imported inflation,” is seen as the driver of “domestic inflation”; rendering national control policies ineffective. The continued devaluation of currency and inflation in the 1980s seems to suggest a correlation between the two variables.

The influence of the exchange rate on inflation depends on the choice of the exchange rate regime. If the exchange rate system is floating, the fluctuations made can have a strong impact on the price level through aggregate supply and demand. In fact, the influence of currency depreciation on a country's price level can be seen from the price of imported intermediate goods. The weakening of the exchange rate will lead to an increase in the inputs price, thereby contributing to a higher cost of production. Manufacturers will certainly increase the price of goods that will be paid by consumers. As a result, the overall price level in the country is increasing or if this continues, it will cause inflation (Madesha, Chidoko and Zivanomoyo, 2013).

Therefore, and using the Granger causality test, Madesha, Chidoko and Zivanomoyo (2013) revealed that the exchange rate and inflation have a long-run relationship. They influence each other during the period considered. Özen et al (2020) for the case of Turkey, as for most authors, found that there is a long-term relationship between inflation rates and the exchange rate and that the effect of the exchange rate change on the producer price index (PPI) is relatively high.

Achsani et al (2010) also found a positive and significant causal relationship between inflation and the real exchange rate. But their study on Asia showed that inflation is statistically insignificant with regard to the exchange rate. Furthermore, the author failed to reject the nullity. Also, Boroumand et al (2019) prove, following the Iran shock, that the underlying inflation rate led, in part, to fewer fluctuations following the depreciation of the exchange rate than some other macroeconomic parameters. This contradicts the theory which indicates that transmission is positively linked to the inflation rate (Jimborean, 2013). This result is consistent with the work of Asari et al (2011) and Ahsan and Ahsan (2022).

More precisely, Kataranova (2010) showed that the improvement of some macroeconomic indicators in Russia did not lead to a reduction in the transmission effect on inflation as in other countries. The transmission effect has a pronounced asymmetric character, that is, consumer prices are more likely to react to the depreciation of the national currency than to its appreciation.

After discussing the main studies dealing with the effect of change in exchange rate regime on macroeconomic factors of Latin American and Eastern European countries as well as other countries in transition (Gürkaynak et al, 2023), and referring always to the traditional approach of macroeconomic theory, we postulate our basic assumptions which state that:

H_1: Economic growth is negatively sensitive in the short term and positively in the long term to any evolution in the exchange rate.

H_2: Exports are positively sensitive in the short and long term to any evolution in the exchange rate. A negative relationship is then estimated with imports.

H_3: Inflation is positively sensitive in the short and long term to any evolution in the exchange rate.

It is now appropriate to ask about the countries in transition in the MENA zone.

3. Data:

Given that the exchange rate system has experienced many fluctuations and affected several variables, and aligning with previous research, we are interested in the effect of exchange rate fluctuations on macroeconomic variables for transition countries in the MENA zone (Tunisia, Morocco, Egypt, and Turkey) for these periods: Tunisia (1993Q1-2022Q4), Morocco (1980Q1-2018Q4), Egypt (2008Q1-2018Q4) and Turkey (1998Q1-2022Q3). The relevant variables for this analysis are: nominal exchange rate (NER), exports (EXPO), imports (IMPO), gross domestic product (GDP) and consumer price index (CPI). All these variables are taken from the International Monetary Fund (IMF) website and are expressed in logarithms.

For Tunisia and Egypt, each annual series of (GDP) was broken down into quarterly data by the method of Chow et al., (1971) using two indicators: “Economic activity, industrial production, index” and “Activity economic, industrial production Energy, Electricity production, Index”.

Descriptive statistics prove that the kurtosis and skewness coefficients, of all variables, have different values from the normal distribution. The skewness coefficients are different from zero, so the series are far from symmetrical. The Kurtosis coefficients are different from 3. The distributions spread then to the left or to the right and reflect a high probability of occurrence of extreme points. The Jarque Bera test confirms our results. It is greater than the chi-square with two degrees of freedom and therefore rejects the hypothesis of the normality of our data series in favor of the existence of strong volatility, particularly for the exchange rate series (see appendix 1). Exchange rate depreciation is the common factor between all chosen periods (crisis periods) and for all four countries.

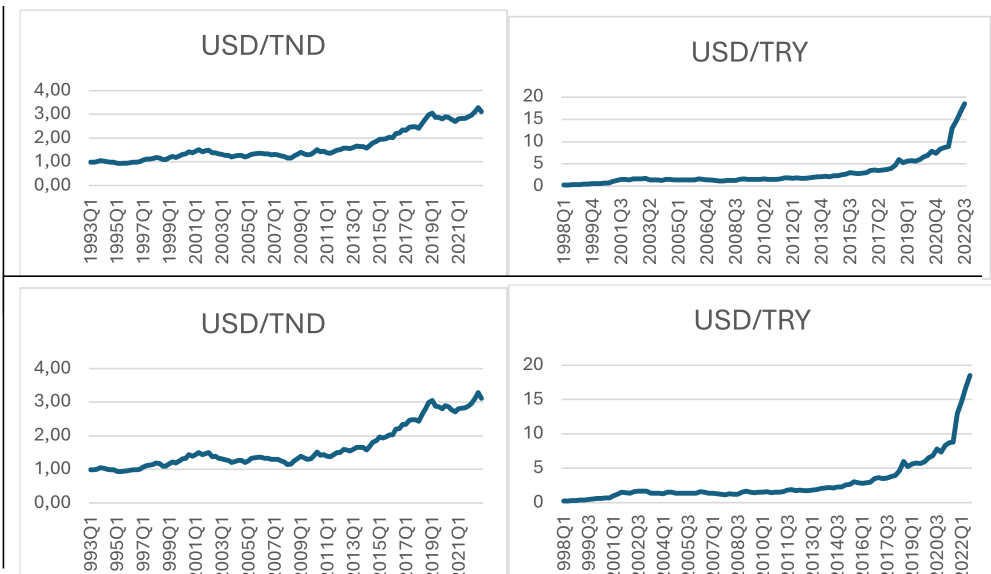

Figure 1. The evolution of the exchange rate in logarithm of the 4 transition countries of the MENA zone (Tunisia, Morocco, Egypt, and Turkey)

4. Empirical methodology:

In order to investigate the dynamic relationship between exchange rate and macroeconomics variables, it is appropriate to conduct an empirical study using developed econometric techniques.

4.1. Econometric Framework:

First, we will use cointegration techniques and the vector error correction model (VECM) to estimate short- and long-term elasticities. The choice of this technique lies in the possibility allowed by the VECM to distinguish on an econometric level between the two equations of the short and long term. The idea of cointegration is that in the short term several variables can have a divergent evolution but evolve in the same direction in the long term. In other words, they evolve with the same rates and the same stochastic trends.

Engle and Granger (1987) showed that a linear combination of two or more nonstationary variables can be stationary. If such a stationary linear combination exists, then the non-stationary series are said to be cointegrated. Thus, after having verified that the variables are non-stationary at a certain level of confidence, we then move on to differentiation. The stationary linear combination is called the cointegration equation and can be interpreted as a long-run equilibrium relationship between the variables.

The Johansen test (1991, 1995) is centered on the examination of the matrix of long-term coefficients. Using the maximum likelihood method, Johansen (1991, 1995) proposed two trace tests to determine the number of cointegrating vectors. These tests make it possible to identify the number of relationships that exist between the variables studied.

$$\lambda_{tracer(r)} = -T\sum_{i=r+1}^{N} I_n(1-\hat{\lambda}_i)$$

and $\lambda_{tracer(r,r+1)} = -TI_n(1-\hat{\lambda}_i)$

Where r is the number of cointegration vectors under the null hypothesis and λ_i is the estimated value of the i^{th} eigenvalue of the Z_t matrix. The presence of a cointegration relationship forms the basis of the error correction specification.

Following Lütkepohl (2005), and assuming that all variables are stationary in levels, the data-generating process can be represented by the following Vector Error Correction Model (VECM):

$$\Delta y_t = \alpha\beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots . + \Gamma_{p-1}\Delta y_{t-p+1} + \mu_t, \quad t = 1,2,3,\ldots \tag{1}$$

Where: Y_t is a K dimensional vector of observable variables and α and β are (K×r) matrices of rank r. More precisely β is the cointegration matrix, and r is the cointegration rank of the process. The term $\alpha\beta' y_{t-1}$ is referred to the error correction term. The $\Gamma_{j's}$, j=1..., p-1 are (K×K) short run coefficient matrices, and μ_t is a white noise error vector.

The VECM model can also represented by MA representation as:

$$y_t = \Xi\sum_{i=1}^{t}\mu_i + \Xi^*(L)\mu_t + y_0^*$$

Where:

$\Xi = \beta_{\perp}\left(\alpha'_{\perp}(I_K - \sum_{i=1}^{p-1}\Gamma_i)\beta_{\perp}\right)^{-1}\alpha'_{\perp}$, $\Xi^*(L) = \sum_{j=0}^{\infty}\Xi_j^* L^j$ is an infinite-order polynomial in the lag operator in the lag with coefficient matrices Ξ_j^* that go to zero as $j \to \infty$. The term y_0^* contains all initial values. Notice that Ξ has rank K-r if the cointegration rank of the system is r. it represents the long-run effects of the forecast error impulse response, whereas $\Xi^*_{j's}$ contain transitory effects.

In order to examine the dynamic relationship between the variables, impulse response is often used. The structural vector error correction model (SVECM) studies the relationship between the variables of the dynamic model.

The most general model of SVECM model can be written as follows:

$$A\Delta y_t = \Pi^*_{yt-1} + \Gamma^*_1 \Delta y_{t-1} + \cdots + \Gamma^*_{p-1} \Delta y_{t-p+1} + C^* D_t + B^* Z_t + \nu_t$$

Where: $y_t = (y_{1t}, \ldots, y_{kt})'$ is a (K×1) vector of endogenous variables. Z_t is a vector of exogenous variables. D_t contains all deterministic terms, the Π^*, Γ^*_j, C^*, and B^* are structural form parameter matrices, and ν_t is a (K×1) structural form error that is a zero mean white nose process. The invertible (K×K) matrix A allows instantaneous relations among the variables in y_t.

4.2. Preliminary tests:

The empirical methodology involves several steps. First, the stationarity of the series is tested by the Augmented Fuller Dickey (ADF) test. This test detects stationarity by determining a stochastic (TS) or deterministic (DS) trend.

Table 1. ADF test results

	NER	GDP	CPI	EXPO	IMPO
Tunisia					
ADF (5% critical value)	-0.900107 (-3.448021)	-0.787611 (-3.448348)	7.627316 (-3.448021)	-2.338090 (-3.449365)	-1.809935 (-3.449716)
First difference (5% critical value)	-4.258098 (-3.450436)	-12.92493 (-3.448348)	-5.847381 (-3.448348)	-8.869076 (-3.449020)	-6.871639 (-3.449716)
Turkey					
ADF (5% critical value)	7.276757 (-3.456319)	-2.038554 (-3.456805)	4.867903 (-3.457301)	-3.431856 (-3.456319)	-2.120006 (-3.456319)
First difference (5% critical value)	-7.555920 (-3.456805)	-13.03242 (-3.456805)	-9.405800 (-3.457808)	-12.43806 (-3.456805)	-9.631184 (-3.456805)
Morocco					
ADF (5% critical value)	-3.060948 (-3.439075)	-1.738150 (-3.440059)	-1.200268 (-3.439075)	-0.689674 (-3.441111)	-1.522013 (-3.440894)
First difference (5% critical value)	-11.91098 (-3.439267)	-5.672859 (-3.440059)	-12.86493 (-3.439267)	-7.217522 (-3.441111)	-5.911032 (-3.440894)
Egypt					
ADF (5% critical values)	-1.742278 (-3.518090)	-1.822593 (-3.520787)	0.380348 (-3.520787)	2.361309 (-3.523623)	-2.159882 (-3.536601)
First difference (5% critical values	-6.728929 (-3.520787)	-4.382279 (-3.520787)	-4.218203 (-3.520787)	-7.776033 (-3.523623)	-9.407163 (-3.520787)

All the adopted variables are not stationary. The ADF test values are all greater than the critical value at the 0.05 level, which rejects the stationarity hypothesis. After carrying out the first differentiation, the ADF values obtained are then lower than the critical values. Stationarity is achieved in the first differentiation, i.e. all variables follow an integrated process of order 1.

Then, using the maximum likelihood method and the two trace tests proposed by Johansen (1991, 1995), it is expected that the calculated value of the trace statistic is greater than the critical value at the 0.05 level to be able to reject the null hypothesis of non-cointegration.

Table 3. Johansen cointegration test results

Tunisia

Number of Cointegrating vector	Eigenvalue	Trace Statistic	0.05 Critical Value	Rank r
None *	0.328171	109.5757	88.80380	0
At most 1	0.222674	63.83439	63.87610	1

Turkey

Number of Cointegrating vector	Eigenvalue	Trace Statistic	0.05 Critical Value	Rank r
None *	0.453991	136.7207	88.80380	0
At most 1 *	0.328215	78.62914	63.87610	1
At most 2	0.198211	40.43876	42.91525	2

Morocco

Number of Cointegrating vector	Eigenvalue	Trace Statistic	0.05 Critical Value	Rank r
None *	0.199995	94.52535	88.80380	0
At most 1	0.183615	60.83160	63.87610	1

Egypt

Number of Cointegrating vector	Eigenvalue	Trace Statistic	0.05 Critical Value	Rank r
None *	0.683549	142.3259	88.80380	0
At most 1 *	0.669771	94.00124	63.87610	1
At most 2 *	0.429551	47.46654	42.91525	2
At most 3	0.310688	23.89063	25.87211	3

Cointegration test results vary from country to country. For Tunisia and Morocco, only one long-term equilibrium relationship is verified. Turkey marked two relationships, while in Egypt 3 long-term relationships are verified at the 0.05 level. However, we accept the null hypothesis that there is at least one cointegration relationship, and we conclude the existence of a cointegration relationship between the exchange rate and other macroeconomic variables.

4.3. The VECM and the SVECM models:

Since these stationary series are also cointegrated, an error correction vector (VECM) will then serve as a basic model to test the causality between these series (Engle and Granger, 1987; Johansen, 1988). For the VAR lag order selection criteria, the number of lags adopted for each country was selected according to the Schawrz Information Criterion (SIC).

Table 4. VAR lag order selection criteria

Lag	Tunisia		Turkey		Marroco		Egypte	
	LogL	SC	LogL	SC	LogL	SC	LogL	SC
0	-3375.971	58.41129	-3679.802	77.70919	-4858.834	64.09728	-1647.723	82.84728
1	-2559.947	45.36640*	-3102.911	66.76252	-3827.621	51.35499*	-1417.169	73.62509*
2	-2525.041	45.78905	-3039.889	66.63412*	-3792.011	51.71273	-1380.982	74.12132
3	-2495.698	46.30761	-2996.234	66.91345	-3759.415	52.11014	-1334.556	74.10554
4	-2468.252	46.85888	-2961.837	67.38770	-3718.534	52.39852	-1291.700	74.26831

For Tunisia, Morocco, and Egypt, the Schwarz Information Criterion (SIC) consistently selects one lag, whereas for Turkey, it selects two lags.

For all countries, we noted the presence of a cointegration relationship (see Table 3). We opted for a SVEC model instead of a SVAR model. In our empirical approach, we followed the methodology of (Affes and Kalai, 2020) to determine the order of endogeneity of the variables. Our y_t will be defined as follows: (NER, GDP, EXP, IMP, CPI).

5. Empirical results:

5.1. VEC Model results:

To identify the existing long-run equilibrium relationship between the exchange rate and other macroeconomic variables, Eviews software is used to estimate the VECM. The central parameter of this estimation is the error correction term, which measures the adjustment speed of a shock to the exchange rate. A negative and significant coefficient indicates that any short-term fluctuation between the independent and the dependent variables will result in a long-term stable relationship between the variables.

Table 5. Adjustment coefficient

	Tunisia	Marocco	Egypt	Turkey
Adjustment coefficient [t-statistics]	-0.022222 [-2.38891]	-0.087640 [-2.72247]	-0.486049 [-1.74818]	-0.100296 [-0.96893]

Egypt:

Egypt has the highest adjustment coefficient among the four MENA countries. It displays a negative coefficient of around (-0.48605) and statistically significant at a 10% level. This means that the short-term imbalance will be adjusted and corrected towards its long-term equilibrium position at a rate of 48.605% per quarter. In fact, Egypt has experienced very intense financial crises and the strongest economic deterioration among all other countries. Starting with the financial crisis of 2008 and the political instability since 2011, ending with the massive depreciation of the national currency in 2016, which lastingly weakened the economy. Therefore, we expect a very marked return to long-term equilibrium. However, these successive shocks in Egypt have negative effects on trade flows and economic growth and have increased inflation (see appendix 2). A positive and highly significant coefficient between the exchange rate and inflation, of the order of (4.3827), proves the existence of a strong long-term relationship between them. This result confirms the long-defended theory suggesting the existence of a positive long-term relationship (Jimborean, 2013) and (Madesha, Chidoko and Zivanomoyo, 2013).

However, the weakening of the Egyptian pound since 2012 has been accompanied by a resurgence in prices, notably through imported inflation. Indeed, although Egypt is a net importer of food and the weight of the food component in the consumer price index (CPI) amounts to 40%, the increase in the exchange rate has certainly repercussions on the evolution of the prices of imported food products and consequently on inflation. This explains the strong long-term relationship estimated. Egyptian trade is negatively affected by exchange rate fluctuations. According to the literature, a depreciation of the national currency will lead to an increase in exports in the long term and obviously a deterioration in imports. But this is not the case for Egypt, which confirms the studies done by Arize, et al., (2008) and Egert, et al., (2008) among others treating the case of countries during transition periods. In fact, given the economic particularity of these countries, the disruptions caused by shocks lead to high input costs and, consequently, reduce the volume of exports. Risk-averse exporting firms reduce their activities due to exchange rate uncertainty to protect themselves from losses. This behavior is reflected in a negative (-3.017) and highly significant long-term relationship (see appendix 2).

For imports, a positive and statistically significant effect, of the order of (0.66035), appears following a shock to the exchange rate. In fact, although Egypt decided to reduce its import policy following the 2008 financial crisis and the 2011 revolution, the devaluation of the Egyptian pound changed the situation (from 5.90 in 2011 to 8.8 in 2016). Due to the changes which seriously deepened, the cost value and consequently the overall cost of Egyptian imports has increased.

These results are awaited. In terms of economic openness, Egypt suffered from an increasingly intense trade deficit during this period due to the weakness of its exports (they focused on products with low added value, products with medium and low technology, petroleum-derived products and textile products) and its incompressible imports (Egypt being the leading importer of wheat in the world, its manufacturing and industrial production is 40% dependent on imported inputs). From a cyclical point of view, Egyptian exports did not benefit from the massive depreciation of the national currency in 2016, because the price effect had a negative impact especially on purchases of imported intermediate goods. Nevertheless, the foreign exchange advantage was largely offset by the resulting inflation and higher input costs.

Also, in the long term, economic growth is negatively affected by the exchange rate shock in Egypt. These fluctuations lead to significant changes in international investment and trade and, therefore, in economic growth. This empirical result confirms recent studies carried out mainly by Hussain et al (2019) as well as Barguellil, et al., (2018) on emerging countries with the same characteristics as that of Egypt. This negative effect is certainly linked to a flexible exchange rate regime which penalizes international transactions and investment operations.

However, before the political crisis, Egypt was the most attractive market for FDI in the MENA region, where the growth rate of the Egyptian economy was around 7%. Its strategic geographical position, low-cost and skilled labor force and unique tourism potential have strongly stimulated the increase in FDI. However, in 2011, the global crisis and the Arab revolution caused a fall in FDI, and inward investment flows declined by 9% between 2016 and 2017 due to economic and political instability. This drop in FDI was accompanied by a drop in the level of trade flows in Egypt and consequently a drop in economic growth during this transition period.

Concerning short-term elasticity, the exchange rate fluctuation has no significant influence on the independent variables except imports. A negative and significant relationship appears. A depreciation of the national currency reduces imports in the short term to reduce the balance of payments deficit. All other macroeconomic variables, exports, inflation, or economic growth are not sensitive in the short term to any exchange rate fluctuation.

Overall, the fall of the Egyptian pound does not have any remarkable consequences in the short term. In the long term, Egypt suffered the opposite effects to those expected from the devaluation policy. This transition period that Egypt is going through is therefore marked by difficulties in reconciling a tense short-term situation, both from a political and economic point of view, and significant long-term challenges in terms of growth. This country is therefore faced with a double challenge: reviving growth while resolving the imbalance which has widened since the beginning of 2011.

The prospects for recovery and the scale it could have remain very uncertain and are suffering from the persistent instability of the political situation.

Tunisia:

Like Egypt, the 2011 Arab Spring revolution led to a continued devaluation of the Tunisian dinar. Also, a negative adjustment coefficient proves that the Tunisian economy returns to its long-term equilibrium state with a speed of 2.22% per quarter. Although the adjustment speed is relatively low, but it is highly significant at 1% risk. For Tunisia, exchange rate fluctuations have implicit effects on other macroeconomic variables. A positive effect on imports and the consumer price index while a negative effect on exports and economic growth (see appendix 2).

However, the Tunisian monetary authorities believe that a depreciation of the dinar stimulates the price competitiveness of exports and at the same time reduces imports. But really, that’s not the case. The marked coefficients are of the order of (-8.9647 and 8.7336) respectively, and statistically significant at 1% risk. Therefore, Tunisian exports and imports are sensitive in the long term to any fluctuation in the exchange rate, but with opposite signs to expectations.

This result invalidates the traditional approach long defended by Khoironi and Ida Ayu (2017) and Anshari et al (2017) among others, and confirms the new approach recently proposed by Ngondo and Khobai (2018), Fredlina et al (2021) as well as Ilmas et al (2022). However, unanticipated currency depreciation makes imports more expensive than low-cost exports, leading to lower trade flows in the long term. This implication is due to a relevant adjustment of the exchange rate and increased competitiveness. However, the Tunisian state has not benefited from the drop in prices given the mediocrity of the goods offered for export (oils, salt, dates) and even import has become expensive, which deals with basic necessities and raw materials that the State cannot sacrifice (hydrocarbons and cereals). Dincer and Kandil (2011) showed that in periods of crisis and transition, developing countries suffer a deterioration in trade flows following exchange rate fluctuations.

Also, the long-term sensitivity of the exchange rate devaluation on the consumer price index is low, on the order of (1.72768), but highly significant at a very low level of risk. Therefore, in Tunisia, inflation increases mainly with the liberalization of the dinar, which increases the prices of imported goods, and inflation is then fueled by repercussions on domestic prices. This process takes place through two channels: a direct channel which influences inflation through the transmission effect of import prices and an indirect channel which influences GDP through the balance of payments.

Along the same path and in line with macroeconomic theory, the decline in the dinar parity should encourage foreign investors to come and invest in Tunisia and stimulate the overall economy and national production. But that's not the case either. The series of experienced crises, during the revolution in addition to political instability, resulted in a long-term negative impact on economic growth (Cambazoğlu et al (2013), Barguellil, et al., (2018)). In fact, exchange rate fluctuations disrupt the foreign investors decisions by affecting production costs, which consequently compromises foreign direct investment.

Furthermore, several other factors linked to the Tunisian revolution could explain this economic deterioration. The deterioration of the security situation, the proliferation of the informal sector and the establishment of a new balance of power, in addition to the upward revision of salaries are all relevant causes for the flight of FDI to other competing countries.

In the short term, no macroeconomic variable is significantly sensitive to fluctuations in the US dollar. Monetary policy remains an option for managing unexpected exchange rate shocks in the short term.

Contrary to IMF predictions, the devaluation of the dinar will have opposite effects on foreign trade. This macroeconomic policy is very costly for the Tunisian economy since it results in a drop in exports followed by a deterioration in economic growth, which leads to an increase in public debt. The Tunisian economic situation is very fragile.

Morocco:

Moving on to the case of Morocco which also experienced a negative long-term adjustment coefficient of the order of (-0.08764) and statistically significant at 1% risk. This result proves that after any shock, the short-term imbalance will be adjusted and corrected towards its long-term equilibrium position at a rate of 8.764% per quarter.

In fact, Morocco experienced exchange rate devaluation three times during the period of 1980-1990, due to an oil shock, a drop in phosphate prices and a rise in interest rates. This devaluation gave rise to a budget deficit, a current account balance deficit and an excessive increase in external debts, which led to the deterioration of the Moroccan situation. The fall in the parity prompted the authorities to strengthen external competitiveness, but on the contrary, exports declined and imports increased (see appendix 2). The results indicate a negative and highly significant long-term sensitivity of exports to any devaluation of the Moroccan dirham (–3.1124), contrasted with a positive sensitivity of imports (5.0093) at the same confidence level.

Moreover, the Moroccan authorities still hope to stimulate the demand for exported goods by foreign consumers in the face of falling prices and that any Moroccan consumer reduces their demand for imported goods. But the reality is completely different. Certainly, there are sectors whose exports have evolved (manufactured products sector) but also others have experienced a significant deterioration (agricultural sector) due to the absence of a hedging structure against exchange rate uncertainty and natural obstacles (drought). This devaluation policy does not really have the desirable consequences. The increase in import prices of raw materials, used in the intermediate consumption of exported products, has strongly penalized Moroccan exporters, which leads to their long-term regression. Imports consist mainly of incompressible products, in particular, basic necessities, energy products, raw materials and capital goods. So, the rise in the exchange rate causes certainly their increase.

With an unexpected result for inflation, the long-term sensitivity of the inflation rate following a policy of devaluation of the Moroccan dirham is negative, of the order of (-12.5424) and highly significant. This result invalidates the long-defended theory and confirms recent studies carried out mainly by Boroumand et al (2019) and Ahsan and Ahsan (2022). A negative coefficient proves that even with the increase in the exchange rate and the increase in import prices, the Moroccan authority seeks to maintain the standard of living and the stagnant purchasing power of consumers through a policy of price stability.

To mitigate the repercussions of rising food and energy prices on households, Morocco has adopted a series of measures including:

- Granting subsidies on certain basic necessities and maintaining pre-existing regulated prices.
- An increasing openness of the Moroccan economy and the multiplication of free trade agreements with its partners which have made it possible to diversify sources and attenuate the shock of external prices.

Finally, this experienced devaluation increased Moroccan economic growth thanks to an increase in its determinant (GDP). The increase in the exchange rate has a positive impact on Moroccan economic growth through the domestic price channel where the authorities have tried to lower the prices of national products abroad. This policy will directly affect national investments and increase production and efficiency. Another channel that links the effect of the exchange rate variation to Moroccan growth is the price of exports. Morocco has reduced the prices of exports abroad to strengthen the external balance and foreign currency resources. This strategy only affects sectors which have shown progress during this study period (the agriculture and phosphate sector).

In the short term, only economic growth and inflation exhibit a negative and statistically significant sensitivity to any devaluation of the Moroccan dirham. The only macroeconomic variables that react instantly to currency crises. It should be noted that initially, Morocco did not benefit from the transition experienced. It took time to reap the benefits of the policy adopted.

Türkiye:

Let us finally move on to the Turkey case, a negative adjustment coefficient of the order of (-0.100296) but statistically insignificant proves that short-term imbalances cannot be adjusted to achieve a long-term equilibrium. Hence the neutrality of the effect of shocks over the long term.

Although this coefficient is marked non-significant, but all the coefficients of different macroeconomic variables are statistically significant and have the expected signs. Therefore, the experienced monetary shock influences real long-term variables without reaching equilibrium. More precisely, Turkish monetary authorities believe that a depreciation of the pound stimulates the price competitiveness of exports and at the same time reduces imports which would become more expensive. Thus, they consider the decrease in the exchange rate value is the appropriate measure to resolve the foreign trade problem. These estimates are confirmed mainly for exports, whose long-term sensitivity marked a positive and statistically significant coefficient of around (1.42428) and for imports with a negative long-term sensitivity equal to (-1.75831) and strongly significant too (see appendix 2). These results confirm the traditional approach defended by Khoironi and Ida Ayu (2017), Thorbecke and Kato (2012) and Aye, Gupta, Moyo and Pillay (2015) among others. The devaluation policy is then successful. In fact, Turkey is a net consumer goods exporter. Mainly food products and beverages, metallurgy and vehicles which have recently experienced a remarkable expansion (Gürsel, 2013). Recently, Turkey gained, in addition to the European market, two new destinations, the Middle East and North Africa. This strategy played a vital role in increasing exports. On the other hand, Turkey is a net importer of intermediate goods and capital, the reduction of which is explained by the double taxation policy adopted by the country.

However, the fall in the lira parity poses two problems. The first is the rise in the price of imported products (raw and semi-manufactured materials), and therefore an acceleration of inflation. This observation is confirmed by a positive long-term sensitivity coefficient of the order of (1.08198) and statistically significant. Despite the drop in domestic demand, the increase in inflation is mainly linked to the increase in the imports cost. Also, the monetary policy adopted by the Turkish government, which consists of a 50% increase in the minimum wage and a further reduction in rates by the central bank, has helped to accentuate the inflation rate.

The second is the slowdown in the country's economic activity. We find a negative effect of exchange rate fluctuations on Turkey's economic growth. The rise in rates leads automatically to an increase in borrowing costs for households and especially for businesses wishing to invest, which has led to a decline in FDI.

In fact, the deterioration of Turkey's economic situation began with the crisis of 2001, which was the most serious financial crisis during the implementation of the anti-inflationary stabilization program supported by the IMF. Turkey's annual growth rate fell by 13% with a large external deficit. This relationship is transmitted via two channels. First, the devaluation of the currency which has reduced the international competitiveness of national products and, consequently, the lack of consumer confidence, and which has a negative impact on savings and investment. In addition, trade openness which is a major channel between the exchange rate and growth. With an export flow affected by an undervalued exchange rate, there is an increase in external demand and an achievement of full employment. This relationship is identical to the study of (Berument, and Mehmet., 2003), who found a negative effect on economic growth in Turkey.

This state can therefore be a source of financial fragility for Turkey if it is not financed by foreign investments.

In the short term, only inflation, through its determinant (CPI), showed a positive and significant sensitivity coefficient. So, inflation is the only variable that responds quickly to the devaluation of the Turkish lira. It feeds then strongly through repercussions on domestic prices.

5.2. SVEC Model results:

We thus present the impulse responses to exchange rate shocks. Each response which has a solid line in the middle represents the estimated response, while the two dotted lines represent the confidence bands. These confidence bands represent the Hall bootstrap method with a 95% confidence interval and 3000 bootstrap replications. We used the JMulTi software for the estimation.

Egypt:

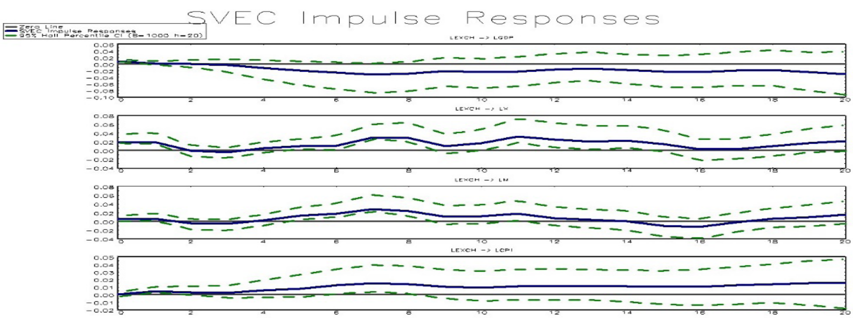

Figure 2. SVEC impulse responses for Egypte

The figure shows the response of macroeconomic variables to the exchange rate shock. It corresponds to the increase of one percentage point in the short-term exchange rate. This response is positive for the CPI, export and import while it is negative for the GDP. Overall, in the short term, the responses are not significant either for inflation or for economic growth. For exports, a positive and statistically significant impact is marked only for the second and eighth quarters while it subsequently tends towards zero. Similar for import whose response is only significant for the eighth quarter.

Tunisia:

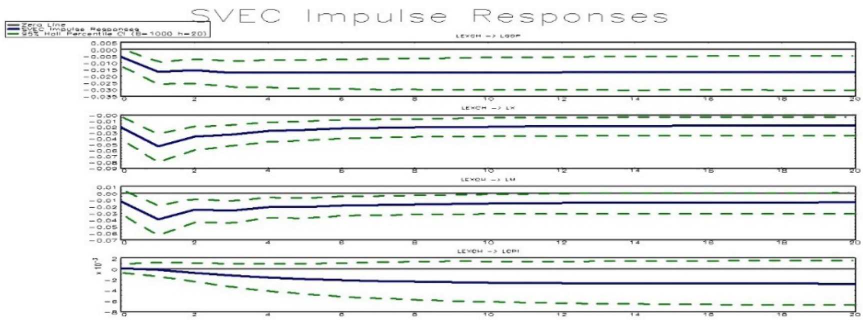

Figure 3. SVEC impulse responses for Tunisia

The response of the four macroeconomic variables to the deterioration of the Tunisian dinar is negative. We observe a negative and abrupt shock on GDP, exports, and imports then it stabilizes over time. This response is significantly marked in the very short term (first quarter) then it disappears, particularly for imports where the effect of the shock becomes increasingly non-significant. The last figure verifies that the response of inflation is completely insignificant.

Morocco:

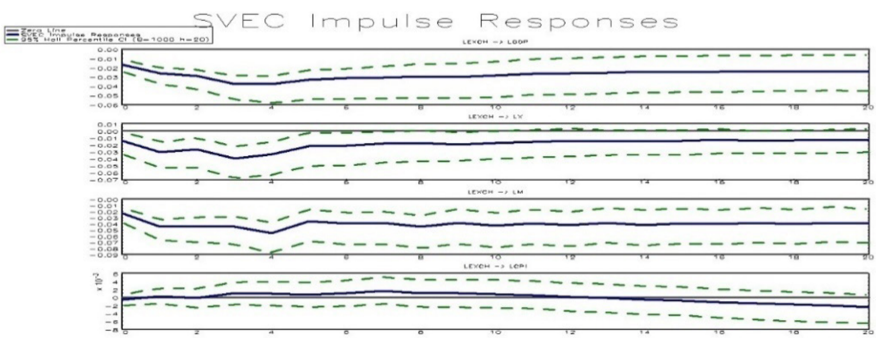

Figure 4. SVEC impulse responses for Morocco

The impulsive responses following the Moroccan exchange rate shock are similar to that of Tunisia. The GDP, exports as well as imports all mark a negative and statistically significant response in the very short term which stabilizes in the long term. The shock response reaches its peak after a year. The behavior of inflation is still insignificant and aligns towards zero.

Türkiye:

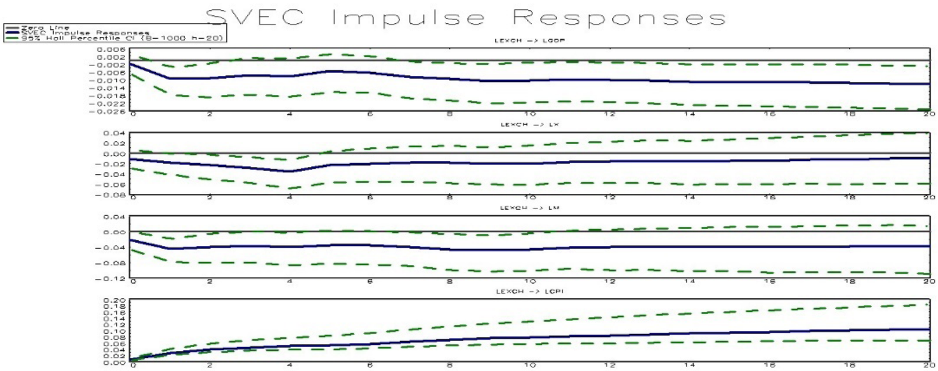

Figure 5. SVEC impulse responses for Turkiye

Finally, the response of the GDP, exports and imports series are all negative and statistically equal to zero. The effect of the shock appears in the very short term, in the second quarter, and it stabilizes subsequently. The inflation rate is the only variable with a statistically significant upward trend. This result confirms economic theory and previous studies treating this subject.

The weak reaction of macroeconomic variables to exchange rate shocks proves that this exchange rate policy does not have any remarkable short- and long-term consequences. These countries suffered opposite effects to those expected from the devaluation policy. These results are the consequences of a badly managed exchange rate policy (Rodrik, 2008)

6. Conclusion:

Countries in transition share certain characteristics that arise following the choice of exchange rate policy: mainly shocks and monetary crises. However, exchange rate fluctuations appear to be a key factor influencing the stability of their macroeconomic fundamentals, albeit in different ways. This has created debates, both theoretical and empirical, discussing its consequences on the economic and political situation of the country. Moreover, a variation in the exchange rate implies changes within economies and pushes the authorities to establish well-defined policies.

Empirical studies, which examined the relationship between the exchange rate and other variables, showed that this tool is of crucial importance. In general, the choice of exchange rate regime is linked to a complicated situation which directly or indirectly affects the vital signs of countries.

Thus, the main objective of this study consists of discussing the long- and short-term sensitivity of the different macroeconomic variables following any variation in the exchange rate. This analysis serves also as a basis for judging the effectiveness of the monetary policy of the countries in our analysis (the transition countries of the MENA zone: Tunisia, Morocco, Egypt and Turkey) in dealing with exchange rate disturbances.

Referring to the vector error correction model (VECM) to estimate short- and long-term elasticities and the structural vector error correction model (SVECM) to measure impulsive responses following the exchange rate shock, we were able to show that the economic fallout from this change of regime, in each of these countries, generated varied effects, both negative and positive. Some disprove while others confirm the theory. The equilibrium adjustment rates are all below 50%, indicating that it will take a long time to adjust to equilibrium in the long run. The highest adjustment coefficient is that of Egypt. This proves that the Egyptian economy underwent strong structural changes, both economic and political, during the study period. All countries (except Morocco) have agreed that the devaluation of the exchange rate will accelerate their inflation rate. Intense volatility in the inflation rate is detected due to an exchange rate shock, aimed at supporting the appreciation of the US dollar against other national currencies. This increase in inflation is mainly due to the increase in import prices of raw materials and semi-finished products which will directly influence producer prices and indirectly consumer prices. For Morocco, a devaluation of the dirham increased Moroccan economic growth thanks to an increase in its determinant (Investment) and therefore inflation will decrease.

Moving on to the trade flow, Egypt, Tunisia, and Morocco experienced similar reactions. The fall of their national currency has generated negative effects on exports and positive effects on imports. In fact, this decrease in parity encourages the authorities to strengthen external competitiveness, but due to the absence of hedging structures against exchange rate uncertainty and the non-diversification of products, exports have declined, and imports have increased. Turkey experienced a contradictory effect. Turkish monetary and political authorities assume that a depreciation of the lira will stimulate the price competitiveness of exports and thereby limit imports. Thus, they consider that the fall in the exchange rate value is the remedy to solve the problems of foreign trade. The fall in the lira parity could also encourage foreign investors to come and settle in Turkey. But in reality, it is more complex, because this logic implies two negative effects: imported inflation due to the increase in the raw materials cost and an increase in external debts denominated in dollars.

However, not all transition countries in the MENA region are adapted to cope with exchange rate shocks. This is why they have not benefited well from the devaluation of their national currency. Their adjustment speed is too slow. Even though this exchange rate fluctuation may have a favorable effect in the short term, but in the long term its consequences on basic macroeconomic variables are catastrophic, which automatically leads to the deterioration of economic growth.

Based on this study results, it is recommended that policymakers in these countries' governments implement vital monetary and fiscal policies to determine the least volatile and most productive exchange rate to manage economic growth sustainable in the long term with their business partners.

This study can obviously be extended by expanding to other macroeconomic and financial variables and by adopting more sophisticated techniques.

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Appendix :

Appendix 1 : Descriptive statistics

Tunisia					
	NER	GDP	CPI	EXPO	IMPO
Mean	1.645476	34691.54	101.8189	2894.048	4087.530
Median	1.380300	40112.09	91.38838	3238.504	4408.438
Maximum	3.284000	50911.10	195.0443	5357.909	7221.292
Minimum	0.929800	13555.30	56.03334	873.1630	1398.490
Std. Dev.	0.648704	11712.60	35.48690	1207.261	1700.906
Skewness	1.069693	-0.327968	0.846379	-0.057411	-0.059179
Kurtosis	2.791627	1.531294	2.747002	1.645293	1.525941
Jarque-Bera	23.10195	12.93675	14.64718	9.242074	10.93429
Probability	0.000010	0.001552	0.000660	0.009843	0.004223
Observations	120	120	120	120	120
Turkey					
	NER	GDP	CPI	EXPO	IMPO
Mean	2.942492	328116.8	125.1015	29222.89	42450.47
Median	1.619600	294692.5	99.43199	32167.94	48001.71
Maximum	18.52045	567227.2	572.4159	65624.16	93974.06
Minimum	0.242215	180549.0	6.657578	6300.915	8059.761
Std. Dev.	3.313453	115551.9	104.5539	15789.01	21484.50
Skewness	2.719404	0.416430	1.874171	0.083630	-0.070257
Kurtosis	11.04780	1.943390	7.545970	2.133404	2.102090
Jarque-Bera	389.1844	7.466584	143.2032	3.213227	3.407196
Probability	0.000000	0.023914	0.000000	0.200566	0.182027
Observations	99	99	99	99	99
Marroco					
	NER	GDP	CPI	EXPO	IMPO
Mean	8.693045	76.75885	55874.12	2448.170	4665.427
Median	8.761050	82.10336	40949.09	1696.195	2639.750
Maximum	11.93800	111.1367	129840.7	7290.914	13120.99
Minimum	3.798500	27.47641	13401.29	426.1300	846.4300
Std. Dev.	1.378428	24.34234	35368.17	1955.821	3951.312
Skewness	-1.148910	-0.443732	0.643040	0.871912	0.787717
Kurtosis	5.716104	1.977522	1.969229	2.382389	2.016907
Jarque-Bera	82.27174	11.91485	17.65718	22.24538	22.41499

Probability	0.000000	0.002587	0.000146	0.000015	0.000014
Observations	156	156	156	156	156
Egypte					
	NER	GDP	CPI	EXPO	IMPO
Mean	8.841014	257030.9	145.4556	126115.1	140683.1
Median	6.913400	257503.6	129.1023	112364.1	133209.3
Maximum	18.12500	355013.4	282.0619	359418.1	322136.1
Minimum	5.323600	148950.9	74.62469	52213.14	51751.30
Std. Dev.	4.717858	54625.57	57.00725	72489.40	70527.31
Skewness	1.329753	-0.110623	0.936406	1.537588	0.963230
Kurtosis	2.958153	2.074019	2.824277	5.438764	3.263610
Jarque-Bera	12.97033	1.661716	6.486892	28.24117	6.931347
Probability	0.001526	0.435675	0.039029	0.000001	0.031252
Observations	44	44	44	44	44

Appendix 2 : Vector Error Correction Estimates

Egypt

Cointegrating Eq:	CointEq1	CointEq2			
LEXCH(-1)	1.000000	0.000000			
LGDP(-1)	0.000000	1.000000			
LCPI(-1)	-4.382781	4.181491			
	(0.46657)	(0.62505)			
	[-9.39357]	[6.68990]			
LX(-1)	3.017072	-4.147703			
	(0.50292)	(0.67374)			
	[5.99910]	[-6.15624]			
LM(-1)	-0.660349	0.913051			
	(0.42696)	(0.57198)			
	[-1.54663]	[1.59631]			
C	-7.793747	4.426526			
Error Correction:	**D(LEXCH)**	**D(LGDP)**	**D(LCPI)**	**D(LX)**	**D(LM)**
CointEq1	-0.486049	-0.610743	0.084942	0.229639	-0.020085
	(0.27803)	(0.12718)	(0.04020)	(0.24456)	(0.15994)
	[-1.74818]	[-4.80201]	[2.11314]	[0.93897]	[-0.12558]
CointEq2	-0.240916	-0.495128	0.075552	0.370213	0.189711
	(0.19689)	(0.09007)	(0.02847)	(0.17319)	(0.11326)
	[-1.22361]	[-5.49735]	[2.65414]	[2.13761]	[1.67495]
D(LEXCH(-1))	0.269700	0.245343	0.029175	-0.155164	0.078928
	(0.23784)	(0.10880)	(0.03439)	(0.20921)	(0.13682)
	[1.13398]	[2.25504]	[0.84847]	[-0.74167]	[0.57688]
D(LGDP(-1))	-0.353299	0.263927	-0.062112	-0.123754	-0.249369
	(0.37200)	(0.17017)	(0.05378)	(0.32722)	(0.21400)
	[-0.94973]	[1.55096]	[-1.15488]	[-0.37820]	[-1.16528]
D(LCPI(-1))	0.701926	0.382653	0.076314	-0.468970	0.420827
	(1.26685)	(0.57952)	(0.18316)	(1.11436)	(0.72878)
	[0.55407]	[0.66029]	[0.41666]	[-0.42084]	[0.57744]
D(LX(-1))	0.198459	-0.213385	0.080002	0.619678	0.473481
	(0.28755)	(0.13154)	(0.04157)	(0.25293)	(0.16542)
	[0.69018]	[-1.62224]	[1.92439]	[2.44996]	[2.86237]

D(LM(-1))	-0.610263	0.090758	-0.058379	-0.433397	-0.702114
	(0.30534)	(0.13968)	(0.04415)	(0.26859)	(0.17565)
	[-1.99862]	[0.64976]	[-1.32244]	[-1.61362]	[-3.99717]
C	0.016647	-0.003769	0.026118	0.050473	0.026016
	(0.04460)	(0.02040)	(0.00645)	(0.03924)	(0.02566)
	[0.37320]	[-0.18473]	[4.05009]	[1.28639]	[1.01390]
R-squared	0.246215	0.584135	0.526735	0.383343	0.596310
Adj. R-squared	0.091025	0.498516	0.429297	0.256385	0.513197
Sum sq. resids	0.385986	0.080771	0.008068	0.298657	0.127735
S.E. equation	0.106548	0.048740	0.015404	0.093723	0.061294
F-statistic	1.586532	6.822473	5.405898	3.019433	7.174715
Log likelihood	38.88667	71.73450	120.1123	44.27331	62.10933
Akaike AIC	-1.470794	-3.034976	-5.338680	-1.727300	-2.576635
Schwarz SC	-1.139809	-2.703992	-5.007695	-1.396316	-2.245650
Mean dependent	0.028832	0.010977	0.030185	0.042057	0.033882
S.D. dependent	0.111756	0.068827	0.020391	0.108686	0.087850

Determinant resid covariance (dof adj.)	6.13E-14
Determinant resid covariance	2.13E-14
Log likelihood	363.1049
Akaike information criterion	-14.90976
Schwarz criterion	-12.84110
Number of coefficients	50

Tunisia

Cointegrating Eq:	CointEq1	CointEq2			
LEXCH(-1)	1.000000	0.000000			
LGDP(-1)	0.000000	1.000000			
LCPI(-1)	-1.727682	-0.047499			
	(0.40023)	(0.09200)			
	[-4.31673]	[-0.51629]			
LX(-1)	8.964756	-1.265714			
	(1.15372)	(0.26520)			
	[7.77031]	[-4.77259]			
LM(-1)	-8.733622	0.457991			
	(1.23439)	(0.28375)			
	[-7.07528]	[1.61408]			
C	8.666425	-3.975103			
Error Correction:	**D(LEXCH)**	**D(LGDP)**	**D(LCPI)**	**D(LX)**	**D(LM)**
CointEq1	-0.022222	0.004403	-0.005493	0.006339	0.096393
	(0.00930)	(0.00973)	(0.00117)	(0.02925)	(0.02856)
	[-2.38891]	[0.45260]	[-4.70601]	[0.21673]	[3.37547]
CointEq2	-0.069334	-0.069923	-0.028403	0.411819	0.496446
	(0.04917)	(0.05142)	(0.00617)	(0.15461)	(0.15094)
	[-1.41012]	[-1.35984]	[-4.60356]	[2.66359]	[3.28893]
D(LEXCH(-1))	0.070280	-0.332415	0.000744	-1.129938	-0.932287
	(0.09609)	(0.10049)	(0.01206)	(0.30217)	(0.29500)
	[0.73138]	[-3.30782]	[0.06167]	[-3.73947]	[-3.16029]
D(LGDP(-1))	-0.053054	-0.352446	0.051808	-0.225540	-0.676141
	(0.09675)	(0.10118)	(0.01214)	(0.30423)	(0.29701)
	[-0.54837]	[-3.48338]	[4.26744]	[-0.74136]	[-2.27647]
D(LCPI(-1))	-0.433869	-1.371612	0.239666	0.540704	1.931870
	(0.70853)	(0.74097)	(0.08891)	(2.22797)	(2.17514)
	[-0.61235]	[-1.85109]	[2.69564]	[0.24269]	[0.88816]
D(LX(-1))	0.047826	0.012286	0.006273	0.129005	0.324421
	(0.05319)	(0.05562)	(0.00667)	(0.16724)	(0.16328)
	[0.89922]	[0.22088]	[0.93995]	[0.77136]	[1.98691]
D(LM(-1))	-0.054875	-0.032655	-0.024211	-0.303297	-0.492146

	(0.05087)	(0.05320)	(0.00638)	(0.15995)	(0.15616)
	[-1.07880]	[-0.61386]	[-3.79302]	[-1.89619]	[-3.15158]
C	0.014039	0.030630	0.007771	0.023095	0.008638
	(0.00828)	(0.00866)	(0.00104)	(0.02605)	(0.02543)
	[1.69491]	[3.53597]	[7.47663]	[0.88670]	[0.33969]
R-squared	0.073367	0.258341	0.391427	0.275205	0.472460
Adj. R-squared	0.014399	0.211144	0.352700	0.229082	0.438889
Sum sq. resids	0.153775	0.168181	0.002421	1.520513	1.449261
S.E. equation	0.037389	0.039101	0.004692	0.117571	0.114783
F-statistic	1.244184	5.473722	10.10725	5.966733	14.07357
Log likelihood	224.4991	219.2157	469.4175	89.31182	92.14347
Akaike AIC	-3.669476	-3.579927	-7.820636	-1.378167	-1.426160
Schwarz SC	-3.481633	-3.392084	-7.632793	-1.190323	-1.238317
Mean dependent	0.009731	0.009364	0.010570	0.013153	0.010988
S.D. dependent	0.037661	0.044024	0.005832	0.133904	0.153233

Determinant resid covariance (dof adj.)	1.57E-15
Determinant resid covariance	1.10E-15
Log likelihood	1194.887
Akaike information criterion	-19.40487
Schwarz criterion	-18.23085
Number of coefficients	50

Marroco

Cointegrating Eq:	CointEq1	CointEq2
LEXCH(-1)	1.000000	0.000000
LGDP(-1)	0.000000	1.000000
LCPI(-1)	12.54238 (2.29852) [5.45672]	-12.96021 (2.22423) [-5.82682]
LX(-1)	3.112417 (3.21613) [0.96775]	-3.948739 (3.11218) [-1.26880]
LM(-1)	-5.009280 (2.78039) [-1.80165]	5.234855 (2.69052) [1.94566]
C	-38.71110	32.05623

Error Correction:	D(LEXCH)	D(LGDP)	D(LCPI)	D(LX)	D(LM)
CointEq1	-0.087640 (0.03219) [-2.72247]	-0.065720 (0.03876) [-1.69572]	0.003025 (0.00779) [0.38815]	0.597704 (0.11083) [5.39316]	0.112559 (0.08954) [1.25705]
CointEq2	-0.085243 (0.03330) [-2.55977]	-0.071318 (0.04009) [-1.77886]	0.005074 (0.00806) [0.62932]	0.617338 (0.11465) [5.38470]	0.115287 (0.09263) [1.24461]
D(LEXCH(-1))	-0.003896 (0.08008) [-0.04865]	-0.227437 (0.09641) [-2.35910]	0.026490 (0.01939) [1.36619]	-1.145424 (0.27569) [-4.15480]	-0.878806 (0.22274) [-3.94541]
D(LGDP(-1))	-0.205339 (0.07068) [-2.90533]	-0.002440 (0.08509) [-0.02867]	0.003441 (0.01711) [0.20110]	-0.565415 (0.24332) [-2.32375]	-0.222876 (0.19659) [-1.13371]
D(LCPI(-1))	-0.641556 (0.32744) [-1.95930]	0.520029 (0.39421) [1.31915]	0.076768 (0.07928) [0.96826]	0.459324 (1.12729) [0.40746]	-0.144396 (0.91079) [-0.15854]
D(LX(-1))	-0.008611 (0.02903) [-0.29665]	-0.093734 (0.03495) [-2.68232]	0.017030 (0.00703) [2.42317]	-0.113821 (0.09993) [-1.13902]	0.186849 (0.08074) [2.31428]
D(LM(-1))	0.018851	-0.042764	-0.017266	-0.268018	-0.721521

	(0.03075)	(0.03703)	(0.00745)	(0.10588)	(0.08555)
	[0.61296]	[-1.15495]	[-2.31866]	[-2.53134]	[-8.43433]
C	0.014141	0.009887	0.008162	0.030371	0.032992
	(0.00455)	(0.00548)	(0.00110)	(0.01566)	(0.01265)
	[3.10904]	[1.80557]	[7.41165]	[1.93964]	[2.60788]
R-squared	0.228802	0.186526	0.372996	0.409076	0.435207
Adj. R-squared	0.191827	0.147524	0.342934	0.380744	0.408128
Sum sq. resids	0.232817	0.337452	0.013650	2.759416	1.801301
S.E. equation	0.039933	0.048076	0.009669	0.137478	0.111075
F-statistic	6.187990	4.782447	12.40762	14.43868	16.07170
Log likelihood	281.5566	252.9763	499.9705	91.17236	124.0136
Akaike AIC	-3.552683	-3.181511	-6.389228	-1.080160	-1.506670
Schwarz SC	-3.394919	-3.023747	-6.231464	-0.922397	-1.348907
Mean dependent	0.005997	0.011255	0.009025	0.015542	0.015681
S.D. dependent	0.044420	0.052070	0.011928	0.174702	0.144379

Determinant resid covariance (dof adj.)	3.71E-14
Determinant resid covariance	2.84E-14
Log likelihood	1309.169
Akaike information criterion	-16.35285
Schwarz criterion	-15.36683
Number of coefficients	50

Turkey

Cointegrating Eq:	CointEq1	CointEq2
LEXCH(-1)	1.000000	0.000000
LGDP(-1)	0.000000	1.000000
LCPI(-1)	-1.081978	0.330509
	(0.10286)	(0.12700)
	[-10.5185]	[2.60254]
LX(-1)	-1.424279	-2.693791
	(0.34455)	(0.42537)
	[-4.13379]	[-6.33277]
LM(-1)	1.758311	1.924147
	(0.28085)	(0.34673)
	[6.26075]	[5.54939]
C	0.115417	-7.113646

Error Correction:	D(LEXCH)	D(LGDP)	D(LCPI)	D(LX)	D(LM)
CointEq1	-0.100296	-0.050610	0.146195	0.050248	-0.115449
	(0.10351)	(0.02974)	(0.02654)	(0.09870)	(0.13268)
	[-0.96893]	[-1.70151]	[5.50935]	[0.50909]	[-0.87014]
CointEq2	0.199230	0.047449	-0.093653	0.080844	0.002497
	(0.08994)	(0.02584)	(0.02306)	(0.08576)	(0.11528)
	[2.21520]	[1.83600]	[-4.06200]	[0.94270]	[0.02166]
D(LEXCH(-1))	0.074860	-0.067444	0.092463	-0.145661	-0.133835
	(0.12988)	(0.03732)	(0.03329)	(0.12384)	(0.16647)
	[0.57638]	[-1.80715]	[2.77710]	[-1.17618]	[-0.80395]
D(LGDP(-1))	-0.614019	-0.222467	-0.010440	0.220102	0.629778
	(0.45277)	(0.13010)	(0.11607)	(0.43173)	(0.58035)
	[-1.35614]	[-1.70992]	[-0.08995]	[0.50982]	[1.08517]
D(LCPI(-1))	0.761849	0.084317	0.268446	-0.205283	0.410745
	(0.30844)	(0.08863)	(0.07907)	(0.29410)	(0.39535)
	[2.47003]	[0.95134]	[3.39509]	[-0.69800]	[1.03895]
D(LX(-1))	0.077985	-0.000505	-0.022508	-0.194255	-0.387723
	(0.15806)	(0.04542)	(0.04052)	(0.15072)	(0.20260)
	[0.49338]	[-0.01112]	[-0.55549]	[-1.28889]	[-1.91376]
D(LM(-1))	-0.082918	0.031505	-0.009648	-0.094498	0.113169

	(0.13482)	(0.03874)	(0.03456)	(0.12855)	(0.17280)
	[-0.61504]	[0.81325]	[-0.27916]	[-0.73510]	[0.65490]
C	0.012964	0.012166	0.029420	0.042902	0.008237
	(0.01917)	(0.00551)	(0.00491)	(0.01828)	(0.02457)
	[0.67635]	[2.20891]	[5.98729]	[2.34736]	[0.33527]
R-squared	0.192585	0.188665	0.764575	0.146603	0.096893
Adj. R-squared	0.129081	0.124852	0.746059	0.079482	0.025862
Sum sq. resids	0.725312	0.059889	0.047665	0.659462	1.191638
S.E. equation	0.090275	0.025941	0.023142	0.086080	0.115712
F-statistic	3.032627	2.956531	41.29142	2.184159	1.364094
Log likelihood	99.81240	220.7765	231.8486	104.4285	75.73301
Akaike AIC	-1.893039	-4.387145	-4.615434	-1.988216	-1.396557
Schwarz SC	-1.680692	-4.174797	-4.403087	-1.775869	-1.184210
Mean dependent	0.043762	0.011207	0.044695	0.023167	0.021238
S.D. dependent	0.096734	0.027729	0.045924	0.089719	0.117238

Determinant resid covariance (dof adj.)	5.92E-14
Determinant resid covariance	3.85E-14
Log likelihood	809.9167
Akaike information criterion	-15.66839
Schwarz criterion	-14.34121
Number of coefficients	50