

# **Inflation targeting in Morocco: a VAR model analysis**

**Mariam Elhaddadi<sup>1</sup> and Mohamed karim<sup>1</sup>**

## **Abstract**

The aim of our work is to conduct a descriptive analysis of the inflation targeting regime. In this context, we will analyze the theoretical underpinnings of the inflation targeting. Initially, we will define the inflation targeting and the motivations for its appearance. Then, we will analyze the prerequisites and the necessary steps for the implementation of this regime, as well as its advantages and disadvantages. In a second step, we will evaluate the adoption of inflation targeting by emerging countries by referring to the study carried out by Scott ROGER. Also, we will verify that Morocco validates the conditions necessary for the implementation of inflation targeting.

In order to analyze the impact of the inflation targeting regime on the Moroccan economy, we will proceed to a VAR model analysis aiming to identify the most significant variables which interfere in the implementation of this new monetary policy in Morocco.

**JEL classification numbers:** E31, E52, C32.

**Keywords:** Inflation targeting, inflation, exchange rate, VAR.

## **1 Introduction**

The task of the central banks is to pursue objectives corresponding to their mandate, defined by the national parliaments or, in the case of monetary union, by an international treaty. These objectives have varied considerably over time and

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are a subject of debate among politicians and economists. Until the 1970s, central banks were generally assigned broad or imprecise mandates involving difficult trade-offs between different objectives. One of the lessons learned from the surge in inflation in the 1970s and 1980s was the need to give central banks a more precise target. Price stability has become the ultimate goal. In order to fulfill this new mandate, central banks mobilized, during the 1970s and 1980s, anchoring policies with intermediate instruments such as the exchange rate targeting policy and the monetary aggregate targeting policy. However, they have not succeeded in ensuring long-term price stability. The search for an alternative anchor was the major concern of many central bankers and many economists. Since the 1990s, the conduct of monetary policy has undergone tremendous changes from a system of direct control of interest rates and monetary aggregates to a system of currency regulation through key interest rates. High levels of inflation and high fluctuations constituted major threats to monetary stability. In February 1990, New Zealand was the first country to adopt a monetary policy aimed at achieving an inflation target. The novelty was that controlling inflation was the main aim of monetary policy and the importance given to accountability and transparency in the implementation of the regime.

Today, 26 countries have an inflation target, almost half of which are emerging or low-income economies. In addition, some central banks in the most advanced countries, including the ECB, the Federal Reserve, the Bank of Japan and the Swiss National Bank, have applied many of the main characteristics of inflation targeting in their monetary policy.

## **2 Literature review**

Inflation targeting has been the subject of several studies by recognized economists such as Ben Bernanke, Frederic Mishkin, and Lars Svensson. Referring to the literature on inflation targeting, we can define inflation targeting as a policy to keep inflation close to a defined target. It involves not only announcing an inflation target, but also publishing inflation forecasts in real time and adopting corrective measures whenever expected inflation differs from the target.

### **2.1. Historical context**

A significant number of countries have adopted inflation targeting for several reasons. A significant inflation persisted for a long time during the 1990s. Previous targeting policies failed because of the divergence in the relationship between monetary aggregates and inflation in a context of financial liberalization. The breakdown of the anchoring of the national currency to external currencies and the development of the financial system as well as the change in financial structures in several countries have encouraged adopting an inflation targeting policy. Central banks now see inflation targeting as their overarching goal on a

global scale. Being fashionable, many countries are particularly interested in it, especially the emerging countries. However, only some of these countries are actually considered "inflation-targeting" countries<sup>2</sup>.

## **2.2. Implementation of an inflation targeting policy**

Some conditions are essential for the implementation of an inflation targeting policy. The first condition is the independence of the Central Bank since it is qualified as autonomous or independent when it is free in the implementation of the instrument of the conduct of monetary policy. In other words, it does not take into account external pressures. The second condition is the stability of the macroeconomic framework: The main objective of the inflation targeting policy is price stability that is maintaining a low and stable level of inflation. It is then very important that prices are not indexed. The third condition is for the country to have a developed and stable financial sector: The notion of credibility and transparency that characterizes inflation targeting policy is based on the fact that markets (banking and finance) must understand the objectives of monetary policy as well as the relationship between them and the predefined measures to achieve them. The fourth condition is for the country to have developed advanced technical infrastructures: One of the fundamental properties of inflation targeting is to focus action on future inflation. The Central Bank must have reliable forecasts. Consequently, it must possess quite developed infrastructures to carry out these forecasts. These developed infrastructures reside, firstly, in the capacity to collect data, secondly in the know-how in order to be able to exploit these data efficiently, and thirdly, in the capacity to define conditional forecast models.

Targeting inflation has four main components (Mishkin, 2004; Heenan, Peter and Roger, 2006). The central bank's mission is to ensure price stability, which is the primary objective of monetary policy, and has a broad operational autonomy for this purpose. A quantitative inflation target is set. It reports on the achievement of the objective in compliance with the transparency requirements of the strategy and its implementation. Then we carry out a prospective assessment of inflation, based on a whole series of information.

## **2.3. Advantages and disadvantages**

Implementation of this policy has several advantages. The aim is to make monetary policy more efficient while improving the decision-making process, increasing public understanding of monetary policy and increasing the credibility of the monetary authorities. It allows for high transparency and simple communication based entirely on two indicators: expected inflation and the inflation target. Inflation targeting also has the advantage of preventing deflation

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<sup>2</sup> Emerging countries that claim inflation targeting but are not recognized as inflation targets by most of the existing classifications include Armenia, Georgia, India, and Serbia.

by offsetting the effects of systematic shocks affecting aggregate demand. According to the economic literature on inflation targeting (Freedman, Batini, Laxton and Kumhof), the disadvantages can be summarized as the setting up of the disinflationary environment: The objective of this environment is to reduce inflation to desired levels. However, this disinflationary period is characterized by a dramatic drop in production. The risk of plunging into a recession is enormous. The other disadvantage is the implementation costs: The institutional framework to be implemented and the strategic choices require investment and reforms at the banking and financial level to make optimal choices. Thus, there may be some doubt that inflation targeting benefits will cover the implementation costs. The absence of an instantaneous signal of inflation targeting policy to the public is a major disadvantage: Given the mechanisms of transmission of monetary policy and their characteristics, actions taken in the context of inflation's targeting are not reflected instantly in the market. In the case of industrialized countries, the problems of inflation targeting are not numerous and sometimes they are reported as only potential problems. Actually, inflation targeting problems are more relevant to emerging countries.

#### **2.4. Inflation Targeting and Emerging Countries**

Although the adoption of inflation targeting by these countries is generally considered a success, the issue of adopting similar policies in developing countries remains controversial. Indeed, the issue of the adoption of inflation targeting by emerging economies has been the subject of much debate for many years. Some saw this monetary policy strategy as a good way to curb inflation in these countries, while others saw the adoption of inflation targeting as premature. Mishkin considered that emerging countries are vulnerable because they have weak financial and tax institutions and low credibility of their monetary institutions, and are vulnerable to capital flows.

Scott ROGER<sup>3</sup> conducted a study comparing similar countries using separate methods and countries that have adopted inflation targeting at others. The date of adoption of targeting by the former being the beginning of 2001, the periods covered by the comparison are 1991-2000 and 2001-2009. His study found the following results: Low-income countries, with or without inflation, experienced sharp declines in inflation rates and markedly improved average growth rates. If those who do not target inflation have continued to have lower inflation and higher growth, the improvement has been more pronounced in both sides in the other countries. In all low-income countries, the volatility of inflation and output has also fallen sharply, but its decline has been more pronounced in those targeting inflation, especially for the volatility of inflation. Among high-income

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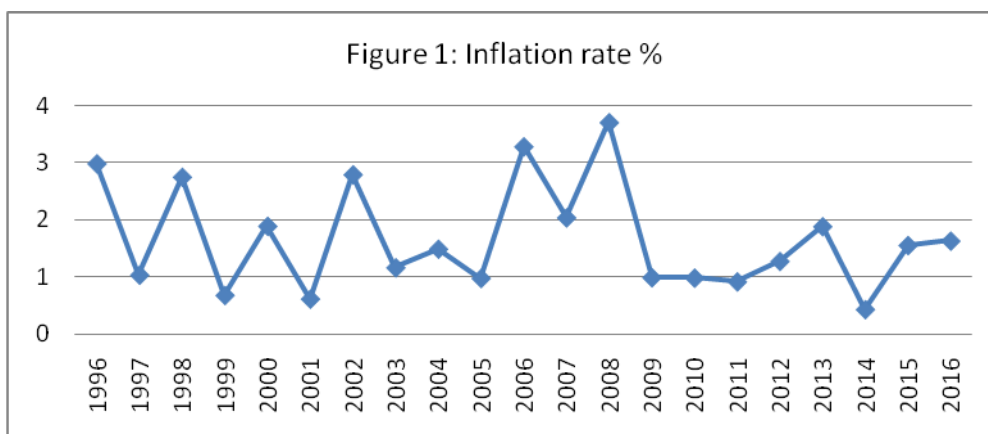
<sup>3</sup> Scott Roger is a senior economist with the IMF's Monetary and Capital Markets Department.

countries, the average performance of those targeting inflation varied little between the two periods, while the others generally saw their growth slowdown. And while the volatility of production or inflation has changed little in countries targeting inflation, production has increased in others. According to ROGER, the adoption of inflation targeting cannot fully explain the improvement in relative outcomes since it was often part of wider, unstructured reforms and policies. But, according to more detailed studies, comparing the same periods in similar emerging countries, macroeconomic variables such as inflation and output are better in those targeting inflation. The International Monetary Fund, for a long time regarded inflation targeting as an inappropriate and too restrictive monetary policy framework for emerging countries. With the great success of emerging countries in adopting an inflation targeting policy, it has become the monetary policy framework recommended by the IMF.

### **2.5. Should Morocco adopt an inflation targeting policy?**

In recent years, Morocco has undertaken several structural reforms which have resulted in the stability of its macroeconomic framework. This tangible direction empowers the country to take the final steps to modernize its economy and develop new policy approaches that are flexible and responsive to the domestic and foreign environment. As in many emerging countries, the acceleration of trade and financial integration in the global economy has important implications for monetary policy. In particular, the current fixed exchange rate regime is moving towards a more flexible exchange rate regime. This dynamic is accelerating, in particular as a result of the deepening of tariff dismantling with the European Union and the signing of free trade agreements with new countries. In addition, the effect of the gradual easing of foreign exchange regulation has had an impact on the country's financial integration. As a result, the increase in foreign direct investment in Morocco and the internationalization of domestic firms have helped to strengthen the integration of domestic and foreign financial systems. In order to analyze the adoption of an inflation targeting regime in Morocco, it is necessary to assess compliance with the basic conditions for its implementation.

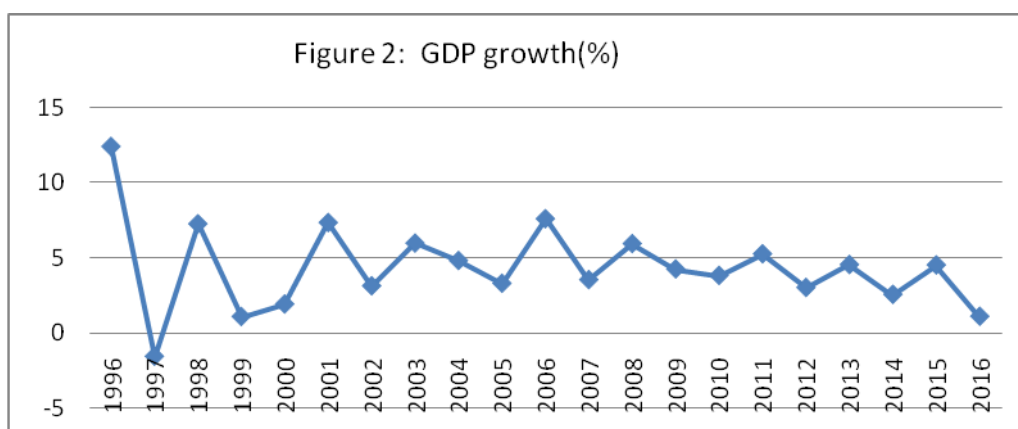
**The stability of the macroeconomic framework:** Morocco has made significant progress in the economic and financial sphere in recent years. The pace of structural reforms has accelerated and major advances have been made in the stability of the macroeconomic framework, of which the control of inflation remains a fundamental element. Indeed, thanks to a successful prudent monetary policy, the rate of inflation has been controlled to acceptable levels. It was reduced to 0.9% in 2009 and 2010 and then to 0.4% in 2014. In 2015, the cost-of-living index recorded a rate of 1.5%.



Source: World Bank

This control of inflation has made it possible to improve the competitiveness of the national economy by maintaining a certain stability of the value of the dirham compared to the main currencies.

In terms of the Real GDP Growth, in 2015, Morocco enjoyed dynamic economic growth (4.9%), up from 2014. This result can be explained by a satisfactory agricultural season. However, the results for 2016 are much less optimistic. Indeed, agricultural activity is declining because of insufficient rainfall.



Source: World Bank

As for public finances, Morocco has gradually moved in the direction of consolidation. The policy pursued in recent years has made it possible to contain the budget deficit at a sustainable level and to develop public savings so as to ensure a greater share of investment expenditure and thus to ease conditions financing of the economy.

**The independence of the Central Bank:** The new statutes of Bank Al Maghrib will strengthen the autonomy of the Central Bank in the conduct of monetary policy and exchange rate policy in the medium and long term, their control and

regulation. Morocco seeks to apply the recommendations of the International Monetary Fund (IMF), giving more independence to the Central Bank. He hoped that Morocco would adopt a flexible exchange rate policy in order to make its economy more competitive. Today, BAM decides on the instruments to be used to carry out the monetary policy decided by the government. The new statutes stipulate that it defines and conducts monetary policy independently. On the other hand, the texts explain that the latter is carried out within the framework of the economic and financial policy of the government and that the bank is the financial adviser of the government. It must consult it and the BAM can also submit its opinions to ensure the financial stability of the country.

**Financial stability:** The combination of a good control of the inflation rate, stable exchange rates and the achievement of a surplus in the current account of the balance of payments for three consecutive years have characterized the Moroccan financial situation in recent years. As for the banking institutions, they comply with prudential rules in accordance with the guidelines and circulars of Bank-Al Maghrib and the stock market performed well in 2016. According to the IMF, fulfill an overall prerequisite for the adoption of inflation targeting: with the necessary operational independence, expertise and statistical resources, and a comprehensive set of instruments that it continues to perfect. Its analytical and operational framework is very similar to that of central banks with explicit inflation targets.

### 3 Methodology

This study examines annual data from 1960 to 2016. The variables included in this study are the Consumer Price Index (CPI), the nominal effective exchange rate, the money supply, terms of trade and GDP. In this paper we will use a VAR model. The VAR model has many advantages. This technique will allow us to identify the structural shocks following the Cholesky decomposition. It also examines the effects of structural shocks of other macroeconomic variables on domestic inflation. It also breaks down the effect of structural shocks on inflation.

$Y = (y_t^1, y_t^2, \dots, y_t^m)$  A stationary vectorial process, center of dimension  $n$ , a modelization VAR (p) of this vector is written:

$$Y = A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + \mu_t$$

With  $A(L)y_t = \mu_t$

$$A(L) = 1 - A_1 L + A_2 L^2 + \dots + A_p L^p + \mu_t$$

While  $t=1 \dots T$ ; iid  $N(0, \Sigma)$

$L$  represents the vector of the roots of the polynomial  $\phi$  whose elements are all supposed to be greater than 1.

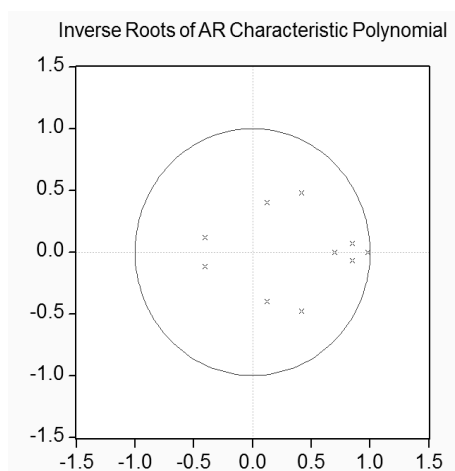
The simulation of a standard VAR model, whose innovations are not instantaneously linked, for example,  $Cov(\varepsilon_t^i, \varepsilon_t^j) = 0 \forall i \neq j$  simulates alternately the effects of a shock on one of the innovations without taking into consideration the possible effects of this shock on the variation of one other innovation.

## 4 Results

### 4.1. Unit root test

The stationarity property of the time series of these variables was tested by the Augmented Dickey-Fuller. This unit root test showed that all series are stationary to the first difference.

**Figure 3**



Source: Authors' calculations.

On the graph, we note that all the inverse roots of characteristic polynomial are inside the circle. Therefore, this model VAR is stationary. This is important because if the VAR is not stable certain results such as impulse response standard are not valid.

### 4.2. Number of lags

Another important specification in a VAR is deciding on the number of lags in the system. Eviews offers a number of useful tools to investigate the lag structure. The most used is the lag length criteria. The number of lag should be sufficient for the residuals from the estimation to constitute individual white noises.



Table 1: Lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-102.0636	NA	3.91e-05	4.040134	4.226011	4.111613
1	233.0800	594.4056	3.25e-10	-7.663397	-6.548138*	-7.234522*
2	265.2966	51.06024	2.54e-10*	-7.935721	-5.891079	-7.149450
3	276.8643	16.15105	4.50e-10	-7.428840	-4.454814	-6.285173
4	316.3537	47.68537*	2.97e-10	-7.975612*	-4.072203	-6.474549

Source: Authors' calculations.

In order to select the optimal delay order for estimating the VAR model, we used the following criterion: LR (sequential modified LR test statistic), FIC (final prediction error), AIC (Akaike), SC (Shwartz) HQ (Hannan-Quinn). The results estimate that the appropriate lag length is 2. Thus, we will estimate this VAR with two lags.

### 4.3. Model estimation

Table 2: Estimate the model

	INF	MM	PIB	TX	ECH
INF(-1)	0.035243 (0.18189)	-0.001022 (0.00138)	0.000390 (0.00159)	-0.034310 (0.03382)	-0.003047 (0.00195)
INF(-2)	0.243901 (0.14952)	0.000162 (0.00113)	0.001442 (0.00131)	0.009186 (0.02780)	-0.002188 (0.00160)
MM(-1)	55.78154 (22.9765)	1.435539 (0.17384)	0.464469 (0.20121)	-8.253699 (4.27148)	0.595373 (0.24579)
MM(-2)	-56.90805 (21.5444)	-0.551969 (0.16300)	-0.326016 (0.18867)	3.620688 (4.00524)	-0.184805 (0.23047)
PIB(-1)	16.17822 (20.6874)	0.137300 (0.15652)	0.605744 (0.18117)	2.981566 (3.84593)	-0.096359 (0.22130)
PIB(-2)	-10.61706 (21.0170)	-0.015068 (0.15901)	0.288512 (0.18405)	2.998715 (3.90720)	-0.121676 (0.22483)
TX(-1)	0.419786 (0.70467)	-0.002666 (0.00533)	-0.001685 (0.00617)	1.121876 (0.13100)	-0.004054 (0.00754)
TX(-2)	-1.268233 (0.67165)	-0.000834 (0.00508)	-0.001637 (0.00588)	-0.463149 (0.12486)	0.005972 (0.00718)
ECH(-1)	-2.475578 (14.8321)	-0.007383 (0.11222)	0.015272 (0.12989)	2.931545 (2.75739)	0.464688 (0.15866)
ECH(-2)	-3.208413 (13.4991)	0.071983 (0.10213)	-0.167756 (0.11822)	-1.097229 (2.50958)	-0.082603 (0.14440)
C	18.31403 (118.034)	-0.750784 (0.89303)	1.380126 (1.03366)	-33.42664 (21.9433)	4.718531 (1.26265)

Source: Authors' calculations.

In this table, each line corresponds to one equation in the VAR. Eviews estimated the coefficients and the standard error. We can note that the R-squares are high. Thus, the model is significant. That is the case generally in the VAR since these models include many lags.

#### 4.4. Impulse response functions

Figure 4

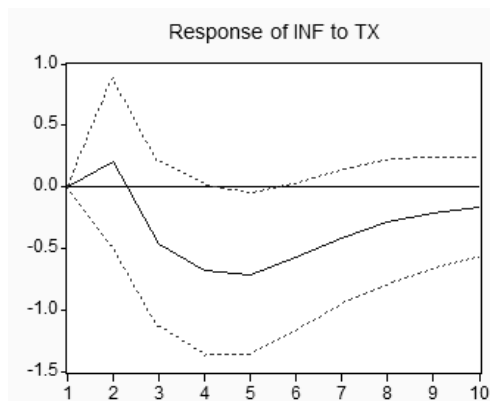
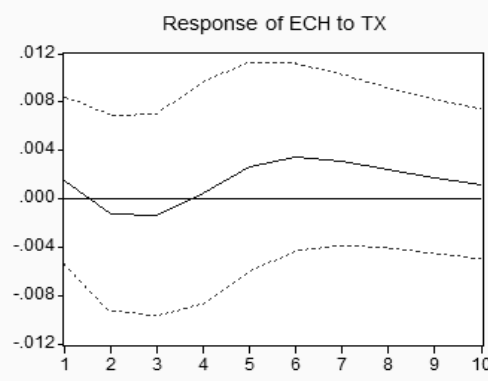


Figure 5



Source: Authors' calculations.

Figure 4 shows that any shock on the exchange rate results in an early reaction to the general price level. The latter increases during the first two years and then falls during the third to the fifth year following the rise in the prices of imported products, to increase again following a renewed confidence in the local demand for imported products.

Figure 5 shows that any shock on the exchange rate negatively influences the terms of trade. The purchasing power of imported goods and services that Morocco holds through its exports tends to decline in the first 2 years to stabilize until the fourth year to resume its upward trend up to the seventh year.

## 5 Conclusion

This study showed that over a period from 1960 to 2016, innovations in the exchange rate resulted in a similar response to the Consumer Price Index (CPI). The degree of pass-through to the consumer price index in Morocco is around 28% in the medium and long term. These results have important consequences in terms of the application of economic policies. First, a high degree of pass-through of the exchange rate to consumer prices influences the forecast of future inflation. Yet an important element in the conduct of monetary policy is the forecasting of future inflation and the conduct of the compensation policies needed to safeguard the purchasing power of households. Second, since import prices are very

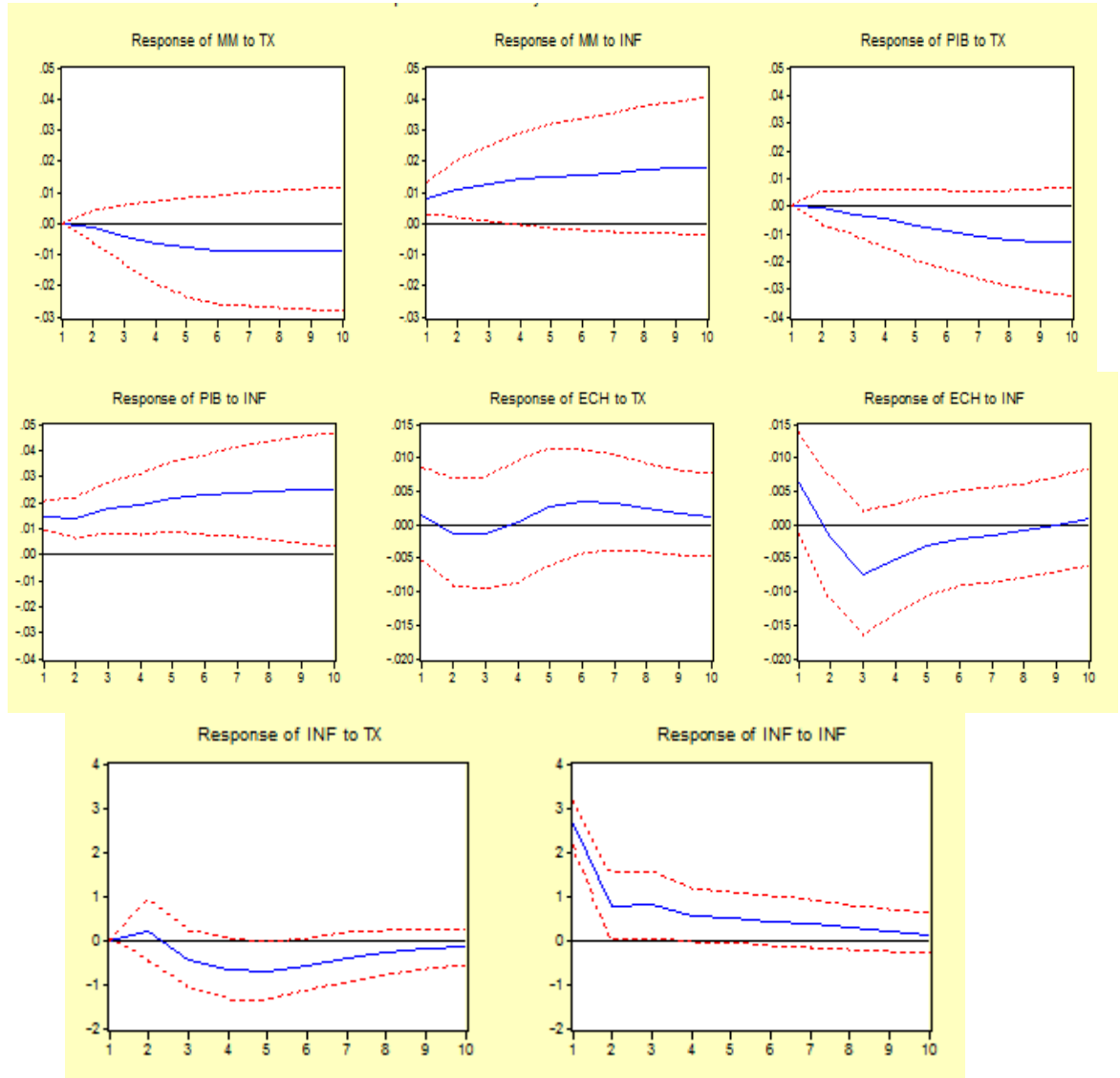
sensitive to exchange rate movements this will not improve the purchasing power of Moroccan households.

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### Appendices

#### Appendix 1: Response to cholesky One S.D. Innovations



Appendix 2: VAR Lag Order Selection Criteria

Endogenous variables: INF MM PIB TX ECH

Exogenous variables: C

Date: 08/26/17 Time: 23:51

Sample: 1960 2016

Included observations: 53

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-102.0636	NA	3.91e-05	4.040134	4.226011	4.111613
1	233.0800	594.4056	3.25e-10	-7.663397	-6.548138*	-7.234522*
2	265.2966	51.06024	2.54e-10*	-7.935721	-5.891079	-7.149450
3	276.8643	16.15105	4.50e-10	-7.428840	-4.454814	-6.285173
4	316.3537	47.68537*	2.97e-10	-7.975612*	-4.072203	-6.474549

\* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

## Appendix 3 : VAR Estimation

Date: 08/26/17 Time: 21:21

Sample (adjusted): 1962 2016

Included observations: 55 after adjustments

Standard errors in ( ) &amp; t-statistics in [ ]

	INF	MM	PIB	TX	ECH
INF(-1)	0.035243 (0.18189) [ 0.19376]	-0.001022 (0.00138) [-0.74279]	0.000390 (0.00159) [ 0.24465]	-0.034310 (0.03382) [-1.01464]	-0.003047 (0.00195) [-1.56608]
INF(-2)	0.243901 (0.14952) [ 1.63124]	0.000162 (0.00113) [ 0.14354]	0.001442 (0.00131) [ 1.10142]	0.009186 (0.02780) [ 0.33047]	-0.002188 (0.00160) [-1.36827]
MM(-1)	55.78154 (22.9765) [ 2.42777]	1.435539 (0.17384) [ 8.25790]	0.464469 (0.20121) [ 2.30835]	-8.253699 (4.27148) [-1.93228]	0.595373 (0.24579) [ 2.42231]
MM(-2)	-56.90805 (21.5444) [-2.64143]	-0.551969 (0.16300) [-3.38625]	-0.326016 (0.18867) [-1.72796]	3.620688 (4.00524) [ 0.90399]	-0.184805 (0.23047) [-0.80187]
PIB(-1)	16.17822 (20.6874) [ 0.78203]	0.137300 (0.15652) [ 0.87721]	0.605744 (0.18117) [ 3.34358]	2.981566 (3.84593) [ 0.77525]	-0.096359 (0.22130) [-0.43542]
PIB(-2)	-10.61706 (21.0170) [-0.50517]	-0.015068 (0.15901) [-0.09476]	0.288512 (0.18405) [ 1.56755]	2.998715 (3.90720) [ 0.76748]	-0.121676 (0.22483) [-0.54120]
TX(-1)	0.419786 (0.70467) [ 0.59572]	-0.002666 (0.00533) [-0.50003]	-0.001685 (0.00617) [-0.27305]	1.121876 (0.13100) [ 8.56372]	-0.004054 (0.00754) [-0.53777]
TX(-2)	-1.268233 (0.67165) [-1.88825]	-0.000834 (0.00508) [-0.16403]	-0.001637 (0.00588) [-0.27835]	-0.463149 (0.12486) [-3.70924]	0.005972 (0.00718) [ 0.83119]
ECH(-1)	-2.475578 (14.8321) [-0.16691]	-0.007383 (0.11222) [-0.06579]	0.015272 (0.12989) [ 0.11757]	2.931545 (2.75739) [ 1.06316]	0.464688 (0.15866) [ 2.92875]

ECH(-2)	-3.208413 (13.4991) [-0.23768]	0.071983 (0.10213) [ 0.70480]	-0.167756 (0.11822) [-1.41906]	-1.097229 (2.50958) [-0.43722]	-0.082603 (0.14440) [-0.57203]
C	18.31403 (118.034) [ 0.15516]	-0.750784 (0.89303) [-0.84071]	1.380126 (1.03366) [ 1.33518]	-33.42664 (21.9433) [-1.52332]	4.718531 (1.26265) [ 3.73701]
R-squared	0.630676	0.999528	0.998896	0.959684	0.994569
Adj. R-squared	0.546739	0.999420	0.998645	0.950521	0.993334
Sum sq. resids	307.4566	0.017600	0.023579	10.62608	0.035183
S.E. equation	2.643416	0.020000	0.023149	0.491428	0.028277
F-statistic	7.513667	9309.520	3979.620	104.7367	805.7067
Log likelihood	-125.3691	143.2565	135.2134	-32.83102	124.2077
Akaike AIC	4.958878	-4.809326	-4.516851	1.593855	-4.116645
Schwarz SC	5.360344	-4.407859	-4.115384	1.995322	-3.715179
Mean dependent	4.469223	10.89065	11.17156	7.358784	10.90704
S.D. dependent	3.926372	0.830609	0.628784	2.209270	0.346350
Determinant resid covariance (dof adj.)		1.05E-10			
Determinant resid covariance		3.46E-11			
Log likelihood		272.2238			
Akaike information criterion		-7.899049			
Schwarz criterion		-5.891716			