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What can nonlinear Taylor rule say about the Egyptian monetary policy conduct?

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ABSTRACT: Using monthly data of Egypt over the period from 2008:M6 to 2013:M1, we extend the linear Taylor rule to a regime-switching framework, where the transition from one regime to another occurs in a smooth way, using a logistic smooth transition regression (LSTR) approach. We find that the nonlinear Taylor rule improves its performance with the advent of special events, such as the global financial crisis in 2008 and the general political instability defined by outbreaks of revolution.
In particular, our results show that the adoption of a nonlinear specification instead of a linear one leads to a reduction in errors of 90 basis points in 2008 and 20 basis points in 2012.

KEYWORDS: Policy rule, Central bank, Taylor rule, Nonlinearity.

1 INTRODUCTION

The traditional approach to analyzing optimal monetary policy is derived from the minimization of a symmetric quadratic central bank's loss function and assuming that the aggregate supply function is linear.

Under these assumptions, the optimal policy is certainty equivalent. This policy can be characterized by a linear time-invariant response to each shock. In such context and under fairly normal circumstances, optimal monetary policy does not focus on risk management.

Recently, a growing number of studies have questioned the two assumptions underpinning linearity. For example, Schaling (1998) and Dolado, Maria-Dolores and Noveria (2005) show that the Phillips curve may reflect more complex price-setting mechanisms than those subsumed in a linear specification and it is also possible that the preference of the policymaker might not be quadratic (Nobay and Peel, 2003; Surico, 2007).

Given the intrinsic complexity of economic relations. i.e; the interconnection among the relevant variables, the structural institution changes, financial disruptions and the interpretation of different phenomena by the economic agents, forces monetary policy to be developed in a highly uncertain world, adopting a more flexible framework for analyzing the behaviour of a central bank is crucial in formulating the appropriate response of monetary policy. This paper designing a set out a comprehensive methodology for optimal monetary policy rules under uncertainty where certainty equivalence does not hold, motivated by the regime switching models where the strength of the response of monetary policy to macroeconomic conditions depends on the level of risk facing the economy.

Recent empirical evidence points to important that nonlinearities in interest rate setting are neglected in the standard specification of estimated Taylor rule. Then, a nonlinear framework seems to be more adequate to explain the behaviour of monetary policy.

Almost all of recent studies focused on nonlinear Taylor rule are limited to industrialized countries, especially US (Lee and Son, 2013; Olsen and al, 2012, Conrad and Eife, 2012), UK (Bruggemann and Riedel, 2010), ECB (Castro, 2008), Japan (Kempa and Wilde, 2011) and Canada (Kolmam, 2013) to name a few.

Thus, the purpose of this paper is to evaluate the behaviour of monetary authorities in MENA countries and in particular Egypt in response to changes in macroeconomic variables over time using the LSTR model in order to investigate a possible deviation from the simple instrument rules and identify the specific rules that characterize the special regime.

The reminder of the paper is organised as follows: section 2 presents reasons justifying Nonlinear Taylor rule. Section 3 describes the methodology applied. The data and preliminary analysis are presented in section 4. We then report the estimations results where the strength of the response of monetary policy to macroeconomic conditions depends on the transition variable. Section 5 concludes.

2 REASONS JUSTIFYING NONLINEAR TAYLOR RULE

While linear models dominate empirical econometric research, there are a number of reasons for expecting changes in the parameters of the models estimated on temporal data.

Recently, there has been a great deal of research activity on monetary policy with time-varying parameter (TVP) because of an ever-growing body of evidence that the usual regression assumption of stable parameters often appears invalid.

There are a host of reasons for expecting changes in the parameters of the models estimated on temporal data.

First, monetary policy reaction functions reflect the importance attached to conflicting objectives and the policy maker's view on the structure of the economy. As such, they may display instability and parameter variation.

Second, central banks utilize broader range of information set while building policy decisions. Thus, for example, if the policy rule is a Taylor type interest rate rules. Then the same levels of output gap and inflation may not produce the same level of interest rate in different periods since the information set used by central banks will be different in those periods.

Besides, unstable nature of the coefficients of a policy rule can be explained by the change in the transmission mechanism of monetary policy.

Moreover, traditional constant parameter reaction functions are likely to blur the impact of institutional reforms. Like the adoption of the inflation targets or the move to a different monetary policy framework, like a fixed exchange rate or managed float regime.

Due to shift in the coefficient of policy rules, interest rate rule should considered as dynamic rule and not statistic because models for policy analysis that do not allow for shift in behavioural relationships may be misleading or inefficient in formulating policy advices.

3 EMPIRICAL METHODOLOGY

3.1 AUGMENTED LINEAR TAYLOR RULE

Our starting point is the estimation of linear Taylor rule. The original Taylor rule has been modified in various ways because central banks seem to look on the broader set of factors.

In order to improve the performance of the rule it became almost standard to add lagged values of interest rate because central banks dislike jumps and tends to take into account the inertia of monetary policy that reflects the smoothness of the typical adjustment pattern.

We also augment the conventional Taylor rule by the REER. Indeed, the work of Svensson (2003) proposes an extension of the Taylor rule by incorporating the exchange rate in a rule designed for small open economies. His conclusion is in line with that of Batini et al (2001) which showed that the descriptive power of the Taylor rule augmented by the exchange rate variable is higher than the standard Taylor rule for small open economies (i.e: UK).

There are several reasons to include the REER in Egyptian reaction function. The constant real effective exchange rate rule provides a buffer against shocks and helps to reduce volatility in interest rate. This policy is partly out of concerns for the international competitiveness of Egypt's manufacturing exports and in particularly aims to prevent excessive appreciation of the real exchange rate when the nominal exchange rate was tending to appreciate.

When dealing with capital flows the authorities confront a trade-off between currency appreciation and depreciation. The former has a negative impact of the competitiveness of exports while the Egyptian pound depreciation induces loses to Egyptian Central Bank by increasing the country massive debt burden.

Thus, the concept of REER goes beyond the weighted average of currencies to greater significance to Egyptian policy makers where sectors are expected to contribute more to the growth of the economy.

Given the importance of exchange rate especially in the context of an open economy, it is widely agreed to introduce it as an explanatory variable in the Taylor rule. To sum up, the inclusion of the REER is consistent with the objectives of the Egyptian Central Bank in terms of maintaining price stability.

The model thus becomes:

$$i_t = \alpha + \rho\ i_{t-1} + b_\pi \pi_t + b_y y_t + b_q q_t + u_{1.t} \qquad (1)$$

Where,

$\alpha = r - \phi\pi^*$ and $b_\pi = 1 + \phi$

i_t : stands for the nominal short term interest rate, r for equilibrium real interest rate. π_t : is the inflation rate at time t, calculated from the consumer price index (CPI), reflecting cost of acquiring a fixed basket of goods and services by an average consumer. y_t : refers to the output gap, defined as the difference between actual output and potential output, which is measured using the Hodrick-Prescott filter (1997). q_t : refers to the REER.

ϕ : indicates the sensitivity of interest rate policy to deviations of inflation from its target. b_y : represents the coefficient of the reaction of the central bank in response to the output gap. b_q : is the coefficient of the reaction of the Central Bank in response to a change in REER. ρ : measures the degree of interest rate smoothing.

3.2 NONLINEAR TAYLOR RULE

As noted in the introduction, the linear Taylor rule even augmented used by many authors are based on two keys namely a linear aggregate supply function and a quadratic loss function for the preferences of the Central Bank.

A number of theoretical and empirical studies in the very recent literature have questioned the two assumptions underpinning linearity.

Thus, the purpose of this paper is to employ an extension of the linear Taylor rule to a regime-switching framework where the transition from one regime to the other occurs in a smooth way.

This class is particularly attractive here since it allows monetary policy to evolve over time. Following the work of Teräsvirta (1998), the standard two-regime STR for a nonlinear Taylor rule could be derived as follows:

$$i_t = \varphi Z_t + \theta Z_t G(\gamma, c, S_t) + u_{2t} \qquad t=1,\ldots,T. \qquad (2)$$

Where $$G(\gamma, c, S_t) = (1 + \exp\left\{-\frac{\gamma}{\sigma_{S_t}^k}\prod_{k=1}^{k}(S_t - c)\right\})^{-1} \quad ; \ \gamma > 0 \ .$$

$Z_t = (w_t^{'}, x_t^{'})$ is a vector of regressors including the exogenous variables, $x_t(1, x_{1t},\ldots,x_{kt})$ and lagged dependent variable, $w_t(y_{t-1},\ldots,y_{t-p})$.

The vectors $\varphi = (\varphi_0, \varphi_1,\ldots,\varphi_n)$, $\theta = (\theta_0, \theta_1,\ldots,\theta_m)$ represent $((n+1)*1)$ and $((m+1)*1)$ parameter vectors in the linear and nonlinear parts of the model, respectively.

The disturbance term is iid with zero mean and constant variables, $u_{2t} \approx iid(\theta, \sigma^2)$.

$G(\gamma, c, S_t)$ is the transition function bounded by 0 and 1, and depends upon the transition variable S_t, the slope parameters γ and the location parameter c.

In terms of above equation, the transition variable increases in tandem with the logistic function. Van Dijk D., Teräsvirta T. and Franses P.H. (2002) demonstrate that as $S_t \to zero\ or\ \infty$, the transition function becomes abrupt, such the model becomes indistinguishable from the linear (AR) model.

Teräsvirta (1994) proposes procedures in building an STR model; these include linearity test, estimation and evaluation of the model. A linearity test is performed for the purpose of choosing the appropriate S_t and the most suitable form of the transition function among LSTR1 (with a single transition variable) and LSTR2 (with two transition variables).

The LSTR model has several advantages over other nonlinear models. First, the LSTR model is theoretically more interesting than the threshold model, which requires an abrupt change in the coefficients. Instantaneous changes in regimes are possible if all agents act simultaneously and in the same direction. However, in reality, the market is composed of many traders acting at slightly different times, making the smooth transition regression model the best structural framework. Second, the LSTR model allows the modeling of different types of nonlinear dynamics and asymmetries based on a transition function (Teräsvirta and Anderson, 1992).

Third, the Markov-switching model assumes that regime changes are driven by exogenous and unobservable processes and therefore does not support economic intuition. However, the LSTR model allows the choice of both the appropriate transition variable and the type of transition function and allows the regression coefficients to change smoothly from one regime to another, unlike the regime changes in other models.

4 DATA

We use monthly data over the period from 2008:M6 to 2013:M1. The data series, which includes the interest rate, inflation rate, outputgap and REER, is collected from the International Financial Statistics (IFS) and Bloomberg databases.

Fig. 1 shows that the time paths of all variables introduced in our model for Egypt.

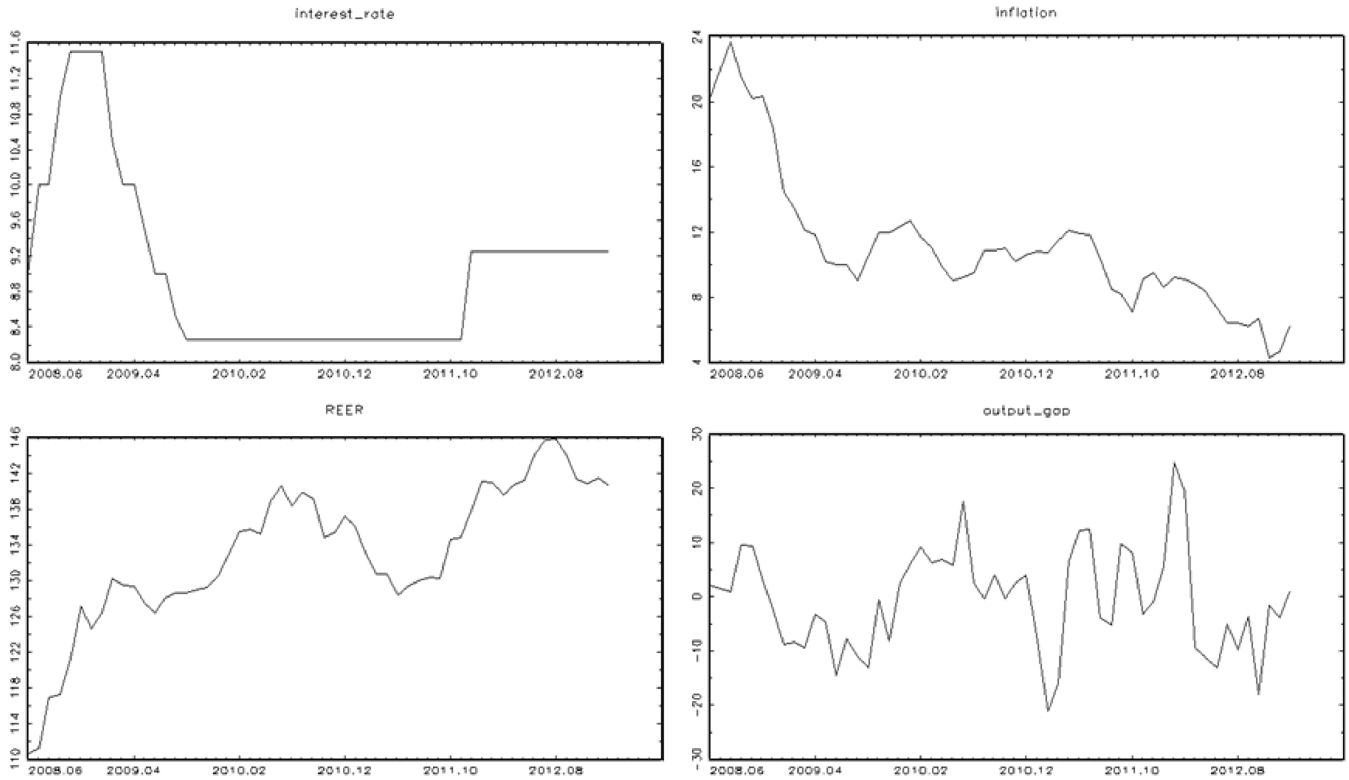


Fig. 1. Time series dynamics

Historically, domestic inflation varied over time with international shocks and domestic pressures.

In 2008, the Egyptian economy suffered from the repercussions of the crisis that exerted significant pressure on the inflation rate, which reached a peak of 23.7% in August 2008.

With the onset of the revolution, inflation displayed a volatile trend, reflecting the conflicting factors affecting inflation.

On one side, depreciation of the domestic currency, the temporary supply shortages that followed the upheaval, coupled with rising global food and oil prices resulted into heightened inflationary pressures during the first half of 2011.

After reaching its peak during the year 2011 in May and June respectively recording the same (11.8%). The inflation started easing as it recorded 7.1% in October: it might be partially due to the slowing growth of the economy and the tightening of monetary policy by the monetary authorities.

The year 2012 witnessed remarkable improvements on the political arena due to the shaping of successful completion of elections of the first president after revolution; Mohamed Morsi and the end of the transitional period.

These improvements cast it shadow over inflation that recorded 4.6% in December 2012.

Moreover, the central bank of Egypt maintained its interest rate unchanged reflecting a neutral monetary stance. However, the CBE decided to tighten monetary policy in November 2011 for the first time since 2008 by almost 0.75 percent.

The CBE attributed such move to tackle rising inflation pressure but also in a bid to prop up the country's swindling reserve and then fight the dollarization process that was triggered since February and March of the year.

Before estimating Eq. (1), it is essential to check for the stationarity of the considered time series. The results of the ADF and KPSS tests are presented in Table 1.

Table 1: Stationarity results

	i_t	π_t	y_t	q_t
ADF	-1.1408	-0.811	-3.7856**	1.764*
KPSS	0.781	1.224	0.0856***	0.608*

Note: This table reports the results of ADF and KPSS stationarity tests. it, πt, yt and qt stand for interest rate, inflation rate, output gap and exchange rate, respectively. 1%, 5% and 10% critical values for the ADF test are -2.56, -1.94 and -1.62 whereas those of the KPSS test are 0.347, 0.463 and 0.739. Respectively ***, ** and * indicate significance at the 1%, 5% and 10% significance levels respectively.

The ADF test results show that output gap and the REER is stationary at the 1% significance level, whereas the interest rate and inflation are not stationary.

Likewise, the KPSS test fails to reject the null hypothesis of stationarity for the output gap and REER. Moreover, according to the same test, the interest rate and the inflation are not stationary.

To remedy this problem, first differencing must be used to make these series stationarity. Consequently, inflation and interest rate are integrated of order one. Yet, output gap and REER are I (0).

5 RESULTS AND DISCUSSION

5.1 LINEAR SPECIFICATION RESULTS

The estimation results of the linear Taylor rule augmented simultaneously by the lagged monetary policy and REER are presented in table 2.

Table 2: Estimation results of linear augmented Taylor rule.

	Estimate	St. error
α	1.056***	0.73
b_{π}	0.031**	0.034
b_{y}	0.08***	0.004
ρ	0.173***	0.134
b_{q}	-0.08***	0.005
AIC	-2.354	
R^2	0.1654	
ARCH(8)	1.3038 [0.9955]	

Note: *This table reports the estimates of the linear Taylor rule augmented jointly by the lagged policy rate and the exchange rate considered in this paper. P-values are between [ ]. ***, ** and * indicate significance at the respective significance levels 1%, 5% and 10%.*

Results shows that all estimates have the expected signs and are significant. However, these coefficients are less than one, which violates the stability condition for the Taylor rule. Additionally, according to the AIC and R2 criteria, we notice a bad overall fit of the model.

The residuals of the estimated linear Taylor rule are Gaussian and not heteroscedastic, which indicates the absence of an ARCH effect in the residuals.

Moving to the graphical analysis, we plot the residuals series form of the regression of equation 1.

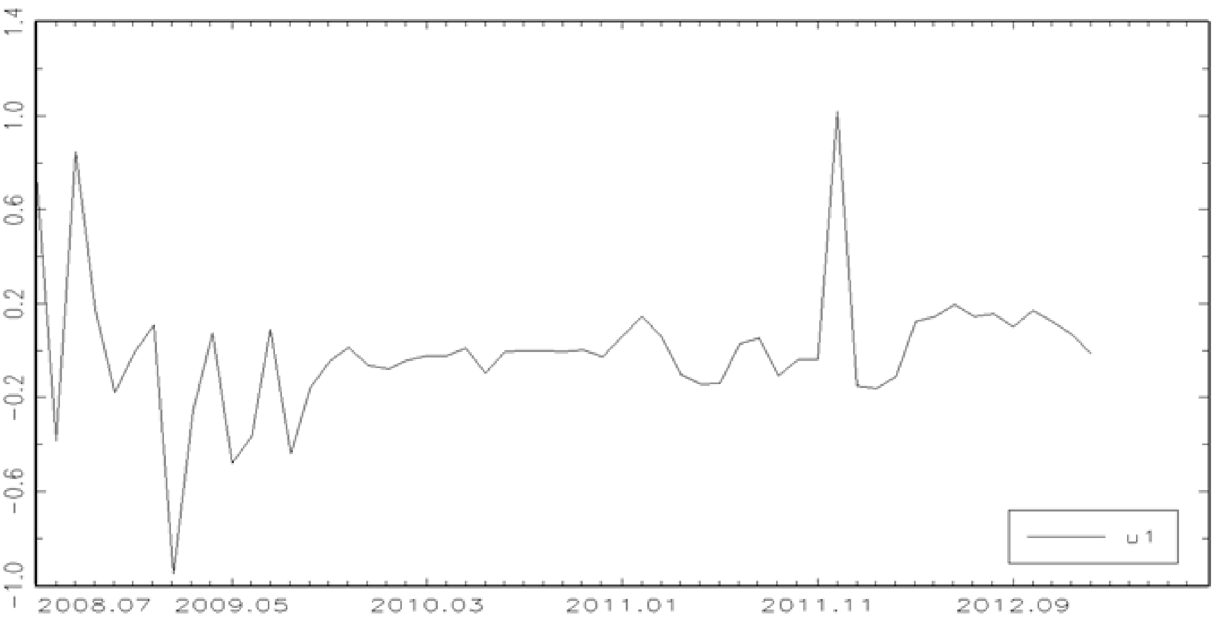


Fig.2. Residual plot from Eq. (1).

At first sight, the rule seems to capture well the behavior of the Egyptian decision makers. However, it is noteworthy those consecutively large residual volatilities for more than one period, notably in the 2008-2009 and 2011:M12. The fitted interest rate is, over these time intervals correlated and remarkably different from the actual value.

Negative (positive) residuals correspond to periods in which the estimated rule leads to a higher (lower) interest rate (repo rate) than the actual rule. In such periods, monetary policy appears to have been tightened (relaxed) beyond that suggested by the inflation, output gap, lagged interest rate and the REER deviations. This phenomenon may be observed because a simple Taylor rule is not able to perfectly describe the conduct of economic policy in the presence of unusual contingencies (Alcidi et al., 2011).

In summary, we can deduce that although the linear Taylor rule describes well the board contours of Egypt's behavior, it fails to detect significant changes in policy direction in response to the unusual contingencies which affected the Egyptian economy. Thus, the actual presence of finer monetary regimes corrupts the descriptive power of linear rules even augmented by the lagged policy rate and REER.

The theoretical basis of the linear rule comes from the assumption that policymakers have a quadratic and symmetric loss function and that the aggregate supply or Phillips curve is linear. However, in reality, this assumption is unrealistic; monetary authorities may have asymmetric preferences [Surico, 2007] and the underlying aggregate supply schedule might be nonlinear leading to a nonlinear adjustment of the policy rate [Dolado et al, 2005].

Therefore, a nonlinear Taylor rule may be the most appropriate rule to explain the behavior of monetary policy, and therefore the adoption of nonlinear specification instead of the linear one leads to fewer errors.

To get a deeper understanding of this phenomenon and to investigate to what extent concerns of monetary policy makers are related to unexpected events, we adopt the LSTR model to test the hypothesis that the strength of the response of monetary policy to macroeconomic conditions depends on the level of risk facing the economy.

5.2 NONLINEAR SPECIFICATION RESULTS

The results of the tests for the selection of transition variables candidates are reported in table 3

Table 3: Testing Linearity against STR results

	F	F2	F3	F4	Selected Model
i_t	Nan	$1.161*10^{-1}$	7.096^{-1}	Nan	***Linear***
y_t	$7.1008*10^{-2}$	$2.038*10^{-2}$	$8.119*10^{-1}$	$2.082*10^{-1}$	***Linear***
π_t	$2.009*10^{-3}$	$2.36*10^{-1}$	$1.275*10^{-4}$	$6.436*10^{-1}$	***LSTR 2***
q_t	$8.858*10^{-4}$	$2.36*10^{-4}$	$1.905*10^{-2}$	$7.943*10^{-1}$	***LSTR 1***

Note: *This table reports the results of the test of linearity against the STR nonlinearity. All numbers in this table are p-values associated with the test. F refers to the test of linearity against LSTR while, F2, F3 and F4 allow to select the adequate LSTR model among LSTR with one threshold (LSTR1) and LSTR with two variables (LSTR2). i, y, π and q refer to the interest rate, output gap, inflation and the REER, respectively.*

Considering that the p-values reported in column 3 and4 of Table 3 are small (<0.001), we conclude that there is strong evidence against the linear specification of the Taylor rule and that the behavior of the inflation and the REER are likely to be responsive for nonlinear behavior of ECB. Thus, the nonlinear specification can be defined using these variables as possible transition variables in the reaction function, implying that the response of interest rates to inflation, the output gap, the lagged interest rate and REER depends on the regime of inflation and the REER regime.

With regard to the choice of the adequate transition variable, the selected variable is the REER because it provides the lowest p-value of the computed F-statistics for the rejection of the null hypothesis of linearity. Therefore, switching between regimes is controlled by REER.

We attribute this finding to the sequence of adverse, supply shocks that hit the Egyptian economy. During, the time spam that we consider in this paper, Egypt underwent several shocks: the global financial crisis in 2008 and the effect of political instability with the onset of the revolution.

When the world financial crisis began, central bankers had expectations regarding its extent. Unfortunately, a series of consequential shocks to the world economy, such as the Lehman Brothers bankruptcy, the AIG flop and the crush of the Reserve Primary Fund (a large money market mutual fund in the US), spoiled these expectations, leading to the demolition of the financial system and the economy (Mishkin, 2011).

Indeed, after the revolution the political instability in the country had increased uncertainty and led to a systematic capital outflow the tourism sector, which prior the revolution had represented 11% of the country's GDP has been severely affected as tourism income plunged by 9 percent after January, 25 revolution which took their toll on the Egyptian foreign exchange reserve.

Our results are consistent with those of Mora and Carvalho (2010), whose findings support evidence of nonlinear Taylor rule for Mexico.

The authors consider several specifications of the Taylor rule to examine how monetary policy is conducted in the seven largest economies in Latin America. They show that the exchange rate is relevant variable for the interest rate in Mexico, establishing the monetary policy rate in Chile, Columbia and Venezuela.

Furthermore, the results relative to the output gap as a transition variable in table 3 show that the F2 statistic has the lowest p-value compared with F3 and F4, suggesting that the LSTR model with one threshold is preferred to the LSTR model with two thresholds.

According to the results in Table 3, the resulting nonlinear LSTR model to be estimated is reported in Eq. (3) below:

$$i_t = \alpha_1 + \rho_1 i_{t-1} + b_{\pi.1}\pi_t + b_{y.1}y_t + b_{q.1}q_t + (\alpha_2 + \rho_2 i_{t-1} + b_{\pi.2}\pi_t + b_{y.2}y_t + b_{q.2}q_t)G(\gamma, c, q_t) \quad (3)$$

LSTR model estimates are reported in table 4.

Table 4: Estimation results of LSTR model

	Linear Part	Nonlinear Part
Intercept	10.918***	-9.818***
i_{t-1}	-0.262**	0.374**
y_t	0.0429***	-0.04459***
π_t	0.0975**	0.1572***
q_t	-0.0889***	0.08143***
γ	3.21**	
c	127.937***	
AIC	-2.776	
R^2	0.583	
Jarque-Bera	280.135	[0.000]
ARCH(8)	0.4087	[0.999]

Note: *This table reports the estimates of the nonlinear Taylor rule. Standard errors are between ( ) and p-values are between [ ]. ***, ** and * indicate significance at the respective significance levels 1%, 5% and 10%.*

Table 4 confirms our conjectures; the estimates clearly reveal the existence of two regimes. One regime is very close to the linear augmented rule reported in table 2 while the other (that we call a finer regime) is at odds with the classical Taylor rule.

The REER is chosen to be the threshold variable because of the important weight that the central bank places on this variable and because this variable provides the lowest p-value for the rejection of the linear model.

This means that the reaction of ECB to shocks depending on whether the level of REER is above or below the threshold value of 127.937.

The transition speed parameter is statistically significant and has an estimated value equal to 3.21, indicating an abrupt change from one regime to another. Indeed, from the estimated STR model, report that $b_{\pi.2} < b_{\pi.1}$. The result indicates a strong reaction of ECB to inflation when the REER is above 127.937 and we also notice that the Taylor principle is not satisfied in both regimes, the estimated coefficient on inflation is always lower than one, which indicates an accommodative behavior of interest rate to inflation.

We also note $b_{y.2} < b_{y.1}$, indicating an asymmetric response from the ECB to the output gap. The result also reveals that $\rho_2 > \rho_1$, that is, there is a stronger response to the inertia of monetary policy during the depreciation regime than during the appreciation regime.

Additionally, $b_{q.2} > b_{q.1}$, suggesting that the ECB pays close attention to the REER when setting interest rate. The response to this variable depends on whether the level of the REER is above or below the threshold value of 127.937.

To consider the graphical analysis and to better appreciate the gain in terms of the fit obtained by leaving the linear rule for the nonlinear specification, in Fig. 3, we plot both the residuals from the augmented linear Taylor rule and the nonlinear specification. We note that the nonlinear estimation works better in periods of structural breaks and reveals less autocorrelation of the residuals compared with the linear Taylor rule.

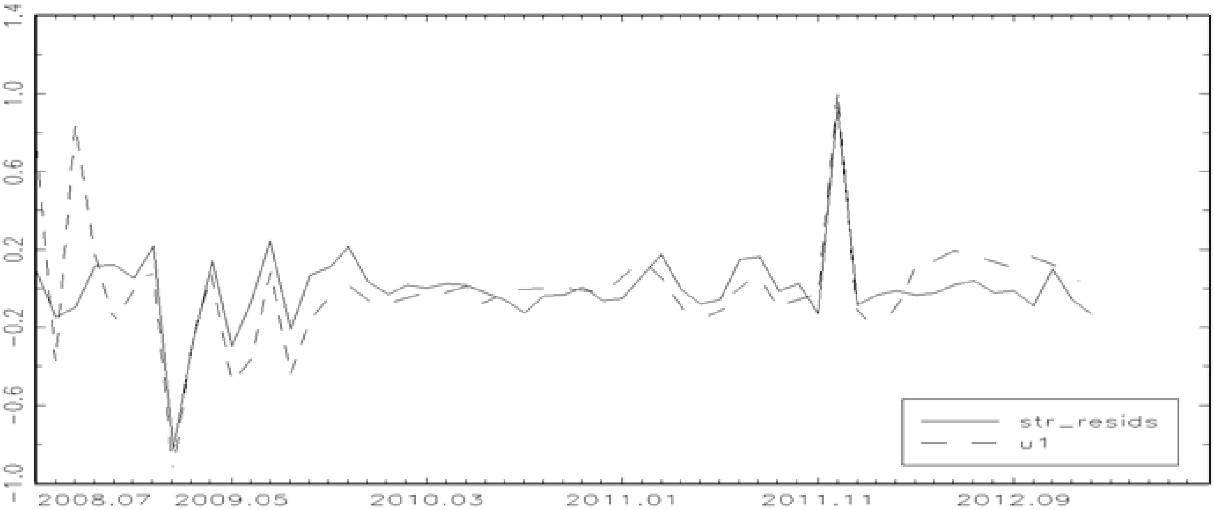


Fig.3. Residual plot from the linear and STR models.

These results indicate that even if a linear Taylor rule describes the broad contours of monetary policy conduct of ECB, the rule fails to detect significant changes in policy direction following the effects of global financial crisis and the general political instability defined by outbreaks of revolution.

These findings suggest that adopting a nonlinear specification instead of a linear one leads to a reduction in errors of 90 basis points in 2008 and 20 basis points in 2012.

Finally, this paper contributes to the recent literature on MENA country, particularly in Egypt, by supporting (i) the idea that the monetary policy followed by the ECB exhibits some nonlinearity and (ii) the existence of changes in the conduct of monetary policy that are determined by special regimes, which may contain relevant information and apply only to unusual economic conditions (appreciation regime).

Indeed, such special regimes refer to some special circumstances in which policy makers extensively use their judgment to make decision.

We perform misspecification tests to check for the robustness of our results and to determine whether there is evidence of parameter instability, non-normality or any remaining nonlinearity. The tests have been proposed by Eitrhem and Teräsvirta (1996). The results of these tests presented in table 5.

Table 5: Diagnostic Tests

Parameter Constancy Test:				
Transition Variable	F-statistic		p-value	
H1	1.4458		0.2149	
H2	1.6721		0.121	
H3	1.7069		0.1295	
No Remaining Linearity				
Transition Variable	F	F2	F3	F4
$TAO(t-1)$	$9.54*10^{-1}$	$9.31*10^{-1}$	$8.929*10^{-1}$	$9.31*10^{-1}$

Note: *This table reports the diagnostic tests of parameter constancy and no remaining linearity. ***, ** and * indicate significance at the respective significance levels 1%, 5% and 10%.*

Moreover, the remaining nonlinearity test shows that the nonlinearity was completely absorbed by a LSTR model with two regimes. Therefore, we find solid evidence of the validity of our empirical nonlinear model. In addition, the parameter constancy test shows that the parameters do not vary over time. Therefore, the results confirm the occurrence of nonlinearity in the Taylor rule.

6 CONCLUDING REMARKS

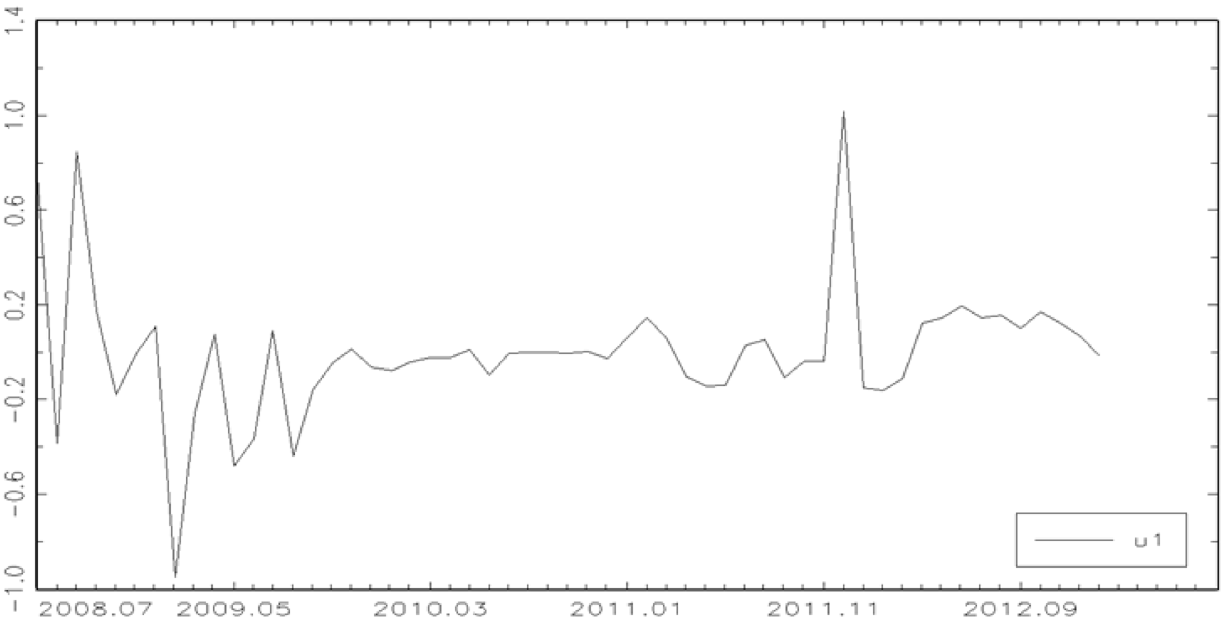
The purpose of this study is to investigate how the Egyptian Central Bank sets interest rates in the context of both linear and nonlinear policy reaction functions.

Using monthly data from 2008 to 2013 to analyze the movement of the nominal short term interest rate for Egyptian Central Bank, we confirm the occurrence of nonlinearity in the Taylor rule. The contribution of this paper is twofold. First, it support the idea that the nonlinear Taylor rule improves its performance with the advent of global financial crisis in 2008 and the political events that unfolded in Egypt since the 25th January revolution, providing the best description of ECB's interest rate setting behavior.

Second, it provides evidence that the Egyptian policy-makers pay close attention to the REER when establishing interest rate.

We conclude that for the analysis of historical monetary policy, the LSTR approach is a viable alternative to track actual interest rate movements to linear reaction function.

Overall, the evolution of coefficients portraits a richer picture of Central Bank's conduct and it is consistent with historical macroeconomic events, which requires disconnection from the automatic pilot rule of the Central Bank and involving a range of judgmental factors that cannot be condensed into a parametric approach when setting monetary policy decision.



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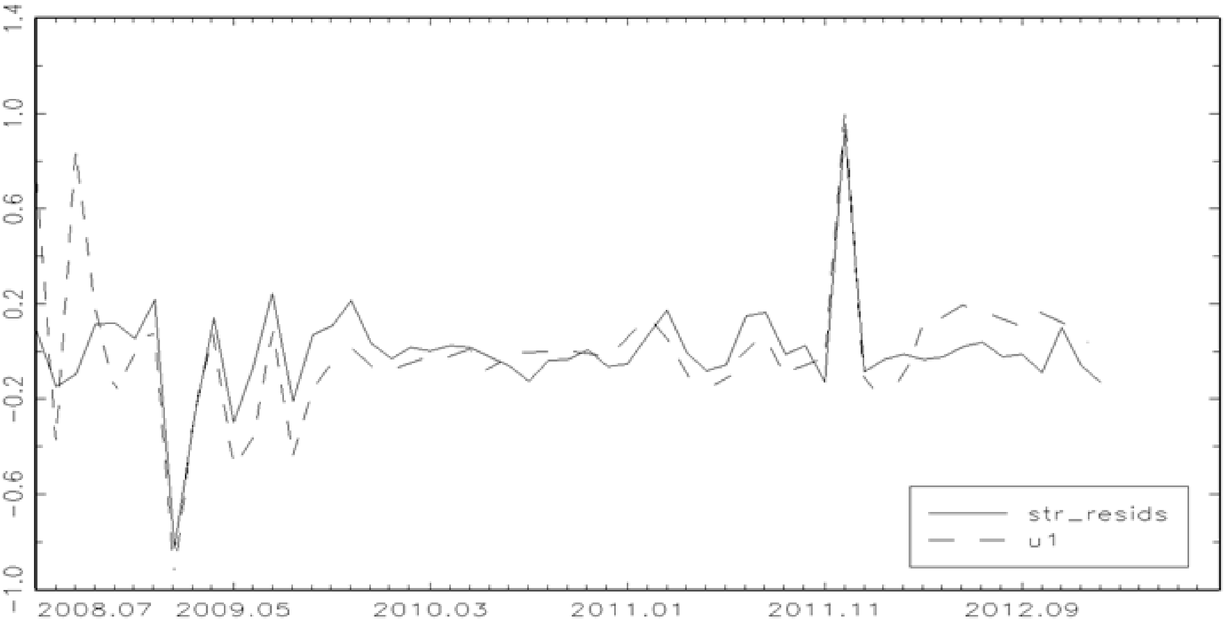

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π_t	$2.009*10^{-3}$	$2.36*10^{-1}$	$1.275*10^{-4}$	$6.436*10^{-1}$	***LSTR 2***
q_t	$8.858*10^{-4}$	$2.36*10^{-4}$	$1.905*10^{-2}$	$7.943*10^{-1}$	***LSTR 1***

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π_t	0.0975**	0.1572***
q_t	-0.0889***	0.08143***
γ	3.21**	
c	127.937***	
AIC	-2.776	
R^2	0.583	
Jarque-Bera	280.135 [0.000]	
ARCH(8)	0.4087 [0.999]	

Note: *This table reports the estimates of the nonlinear Taylor rule. Standard errors are between ( ) and p-values are between [ ]. ***, ** and * indicate significance at the respective significance levels 1%, 5% and 10%.*

Table 5: Diagnostic Tests

Parameter Constancy Test:				
Transition Variable	F-statistic		p-value	
H1	1.4458		0.2149	
H2	1.6721		0.121	
H3	1.7069		0.1295	
No Remaining Linearity				
Transition Variable	F	F2	F3	F4
$TAO(t-1)$	$9.54*10^{-1}$	$9.31*10^{-1}$	$8.929*10^{-1}$	$9.31*10^{-1}$

Note: *This table reports the diagnostic tests of parameter constancy and no remaining linearity. ***, ** and * indicate significance at the respective significance levels 1%, 5% and 10%.*

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