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RESEARCH ARTICLE



Monetary policy in times of uncertainties: evidence from Tunisia, Egypt and Morocco

Brahim Guizani  ^{a,b,c} and Agata Wierzbowska  ^d

^aCenter for South Asian and Middle Eastern Studies, University of Illinois at Urbana-Champaign, Champaign, IL, USA; ^bTunis Business School, Université de Tunis, Tunis, Tunisia; ^cThe Research Laboratory L.R. MASE (LR21ES21), ESSAI, Université de Carthage, Tunis, Tunisia; ^dGraduate School of Economics, Kobe University, Kobe, Japan

ABSTRACT

This study assesses the actual monetary policy stance in three countries in the MENA region, namely, Tunisia (between 2000 and 2017) and Egypt and Morocco (between 2007 and 2017), based on the Taylor rule framework. Especially, it explores the impact of transition periods and high uncertainties following the so-called Arab Spring on the central bank decision-making process. The results provide no strong evidence in favor of rule-based monetary strategies on the part of the central banks in these countries, which still largely rely on discretion when deciding their policy rates. Nevertheless, they show a remarkable presence of interest rate inertia in the policymaking of these monetary authorities. Moreover, our findings reveal a strong dependence of the policy rates in Tunisia and Egypt on the variations of exchange rates, especially during the agitated and inflationary periods of transition. However, some signs of an orientation toward rule-based policies seem to arise in case of Tunisia and Morocco in the transition period, with increased sensitivity of short-term interest rate to inflation gap in the former and to output gap in case of the latter country; yet the confirmation of this evolution requires more time. Furthermore, the estimation of a threshold model where the threshold variable is allowed to vary over time demonstrates the existence of certain opportunistic behavior on the part of the central banks of Tunisia and Egypt. The responsiveness of their monetary policies is more intense when the inflation rate exceeds a certain intermediate target.

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1. Introduction

In January 2011, a popular uprising broke out in Tunisia and ended up by ousting the then President Ben Ali, who ruled the country with a rod of iron for more than twenty-three years. This event has escalated, and a ripple effect spread in several other countries in the MENA region, such as Egypt, Morocco, Libya, Syria, and Yemen, which, likewise, experienced popular unrest and political instability that are still taking place at the time of writing this paper. This process, coined as the *Arab Spring* by some Western observers, has, in an environment of considerable uncertainties, put several MENA countries on

a track of transition toward not only a new political regime of democracy and freedom but also new economic and social contracts. Recall that the principal trigger of the uprisings was economical and particularly related to youth unemployment. For the time being, it is too early to say that these countries are back to normal; they are still passing through a transition stage with all their uncertainties and risks.

Given this background, we are interested in how the transition process following the Arab Spring events has affected the decision-making process of the central banks in three MENA countries: Tunisia, Egypt, and Morocco. We also examine whether the transition period with its uncertainties and risks led to more or less rule-based decisions. This question is of paramount importance as less discretion in monetary policymaking should lead to the more desirable long-term policy outcomes (e.g. Mishkin, 1999) and might thus contribute to economic stabilization and growth in the countries under consideration. In fact, in a discretionary regime, central banks set, at each period, their monetary policy according to the current state of the economy and private sector expectations. Given this fact, any promises of the monetary authorities about the future are not credible because the public knows in advance that the central bank will not resist the temptations of changing the policy settings whenever the state of the economy changes. The alternative regime is a rule-based policy where a central bank makes credible promises to the public about its actions in the future. By committing to its policy, the central bank can influence the public's expectations about future inflation and thus current inflation. According to the New Keynesian model, in which the forward-looking expectations play an important role, a central bank can influence these expectations better and be more successful in stabilizing inflation, when it commits to a policy regime, rather than when it conducts its policy in a discretionary manner (Walsh, 2017).

Taylor (2012) compared the performance of the two alternative regimes, namely, Discretion and Commitment, in the US in an empirical study over a period of three decades and showed that during the rule-based era from the mid-1980s until early mid-2000s, the economy was remarkably stable; inflation and interest rates and their volatilities fell compared to the inflationary 1970s, and the volatility of the real GDP decreased by half. In addition, economic expansions became longer and stronger, whereas recessions became shorter and weaker. In contrast, the discretionary era was characterized by a massive housing boom and a bust with excessive risk-taking, a financial crisis, and a Great Recession. Moreover, the economic recoveries were lower than previously and the unemployment has remained high. The advantageous performance of the commitment to a rule in conducting monetary policy is confirmed by Nikolsko-Rzhevskyy et al. (2014), who found that economic performance is uniformly better during rule-based eras than during the discretionary eras based on various loss functions.

As shown in panel C of Figure 2, except for Morocco, the inflation rate in Tunisia and Egypt has been persistently high in the post-2011 period compared to before 2011. Figure 1 illustrates the instability of the real economy in these three countries since the early 2000s and shows the fall in their economic growth since 2011.

The central bank's decision-making process depends on the context in which it operates, such as the transitional periods of the tumultuous political process and volatile environment. During transitions, the institutions important for monetary transmission are to a certain extent weakened, economic difficulties like budgetary deficits, the collapse of the financial system, and inflationary expectations linked to exchange rate movements could hamper the transmission mechanisms of monetary policy. This environment might

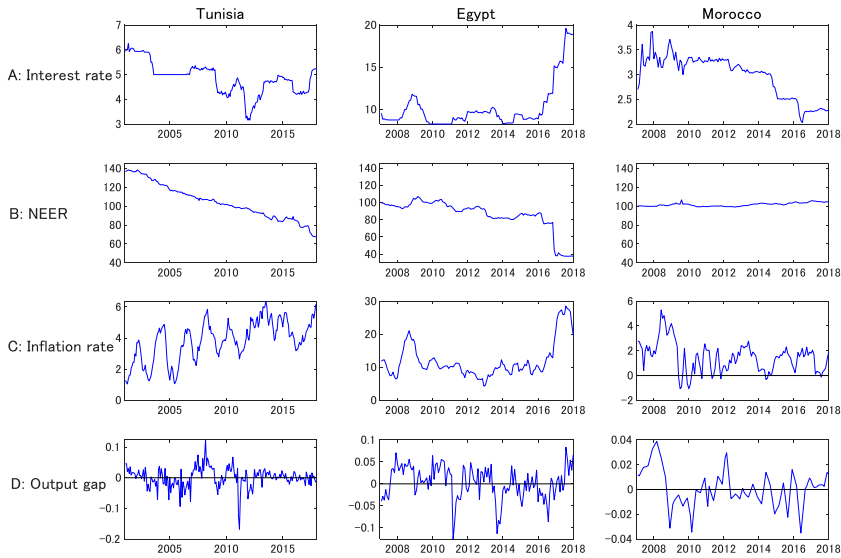


Figure 2. Data used for empirical analysis.

Sources: IMF IFS, World Bank, Datastream, Central Bank of Tunisia (see details in Section 4).

also lead the central bank to inconsistent actions (Ganev et al., 2002). Additionally, if political pressure on the central bank intensifies during the transition period, the bank might use a more discretionary policy following the current political needs.

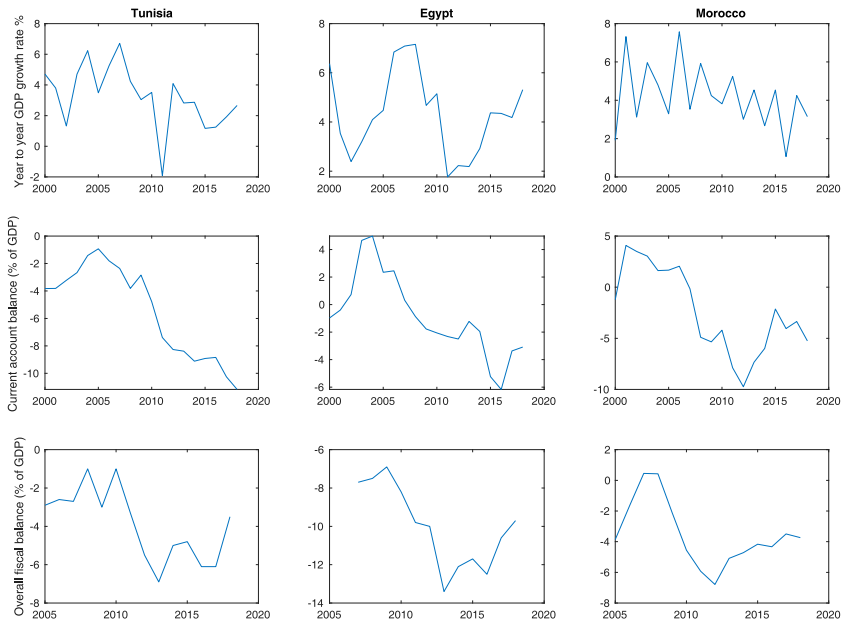


Figure 1. Year-on-year GDP growth rates, current account balance, and fiscal balance, as percentages of the GDP.

Sources: World Bank, each country Ministry of Finance.

However, the transition can make a central bank follow a more rule-based policy if an effect is a more independent, transparent, and accountable central bank. As Mishkin (1999) stated, transparency and accountability are crucial to constrain discretionary monetary policy and thus produce desirable long-term outcomes. To achieve these features, the central bank might commit itself to some easily definable policy target and policy rule that allows its achievement.

To evaluate the monetary policy decision-making process in the three aforementioned Arab Spring-hit countries in the MENA region, we base on the Taylor rule framework to describe the central banks' policies and compare the estimations for the periods prior to and after the outbreak of the transition. Further, we also estimate the threshold model for the Taylor rules to check for a possibility of opportunistic monetary policy in the countries under interest.

Note that the Taylor rule is a monetary policy rule that quickly became popular among many central banks globally, after it was first presented by Taylor (1993). The main reason for its popularity is its simplicity compared to previous models viewed as complex. Many emerging countries adopted this monetary policy rule to control their inflation rate, e.g. New Zealand and Chile (Taylor, 2017).

Further, central banks in many MENA countries, such as Tunisia and Egypt, have mentioned many times their intentions to implement the inflation-targeting framework. One of the main operational prerequisites to implement this new regime is that central banks' policy rate follows a rule, notably the Taylor rule (De Gregorio, 2013).

Taylor rule is a guideline for central banks. It relates the interest rate to inflation and GDP gaps and hence a monetary policy following this rule aims at the stabilization of the prices and business cycles. The post-Arab Spring period is a period of high uncertainty and economic instability; therefore, this study aims to investigate whether central banks in the studied countries have counted on a rule-based policy, such as the Taylor rule, to control the soaring inflation and stabilize business cycles.

To the best of our knowledge, this study is one of the few papers that describe and evaluate to what extent the monetary policy rules explain the behavior of central banks of three non-oil-based economies in the MENA region. It is also the first one to assess the impact of transition periods and uncertainties they go through on monetary policy decision-making. It also contributes to the still rather scarce literature on monetary policy rules in developing countries. This research gains further importance from the fact that in recent years, and like many other emerging economies, Tunisia, Egypt, and Morocco have shown their intention to gradually switch from fixed to some forms of flexible exchange rate systems. As Taylor (2000) emphasized, the only way for an emerging country to have a sound monetary policy after resigning from the fixed exchange rate system is to implement the system based on the trinity of a flexible exchange rate, an inflation target, and a monetary policy rule.

The rest of the paper is organized as follows. Section 2 presents the monetary policy frameworks in Tunisia, Egypt, and Morocco. Section 3 reviews the related literature. Section 4 provides the model to be used in the empirical research and describes the data. Section 5 presents the results of the benchmark model estimations, and Section 6 provides estimations of the threshold model. Section 7 concludes and provides policy implications.

2. Monetary policy frameworks in 2000–2017

2.1. Tunisia

Under the Central Bank Law, the priority objective of monetary policy in Tunisia is to preserve price stability, coupled with the promotion of growth and fighting unemployment. The main policy instrument is the short-term interest rate, also called the money market interest rate (hereafter, TMM). Based on monetary aggregate targets, the Central Bank of Tunisia (CBT) calibrates its monetary operations and aims to keep short-term interest rates within a targeted range. According to Chailloux et al. (2009), around 80% of Tunisian banks' loans, irrespective of their duration, are indexed on the TMM. Consequently, any change in the central bank's policy rate immediately impacts the cost of most bank loans, new and old ones.¹

2.2. Egypt

According to the law, the Central Bank of Egypt (CBE)'s mission is to achieve a low rate of inflation over the medium term. Until June 2005, the CBE's monetary policy tool was quantitative and based on targeting excess reserves. However, since this date, the monetary policy tool changed to the interest rate corridor to control the volatility of the Overnight Interbank Rate. The ceiling of the corridor is the overnight lending rate, and the floor is the overnight deposit rate. The corridor rates are decided by the Monetary Policy Committee which meets every six weeks.²

2.3. Morocco

The main mission of the central bank of Morocco (officially Bank Al-Maghrib–BAM) is to preserve price stability in the medium run. Until 2005, the monetary policy instrument was quantitative and based on a monetary growth target by reference to M1. However, since 2006, a year of important reforms in the banking law and a period when the central bank's independence in terms of policy implementation was reinforced, the BAM started using two main instruments for its conduct of monetary policy: policy rate and reserve rate. The key policy rate is an interest rate on the BAM's seven-day advances. Through this rate, the BAM controls the weighted average rate on the interbank market. Meanwhile, in the required reserve rate, the central bank board meets every three months according to a fixed schedule and decides on key interest rates on the monetary policy.³

3. Literature review

This paper is based on two strings of literature. The first one regards monetary policy rules in general and the second analyzes the implementation of the rules in developed and developing countries.

¹<https://www.bct.gov.tn/bct/siteprod/page.jsp?id=91&la=AN>.

²<http://www.cbe.org.eg/en/MonetaryPolicy/Pages/GeneralDefinition.aspx>.

³Bank Al-Maghrib Annual Report 2005, Box 5, page 91; Bank Al-Maghrib Annual Report 2006, page 68; BAM's website: <http://www.bkam.ma/en/Monetary-policy/Strategic-framework/Presentation>.

The idea of following a monetary policy rule rather than discrete actions is at least as old as Friedman (1960), who proposed that central banks follow a rule based on the supply of money to control inflation efficiently. Since then, various types of rules have been proposed (e.g. McCallum, 1987, 1988). The discussion on rules versus discretion has been still present with a major consensus on the advantage of policy rules in ameliorating policy performance (e.g. Barro & Gordon, 1983; Blanchard & Fischer, 1989; Kydland & Prescott, 1977) but also some voices are pointing at discretionary policy (e.g. Laidler, 1993).

Responding to the previously suggested sophisticated and complicated monetary policy models, Taylor (1993) suggested a simple linear monetary policy rule in his seminal work. This rule is based on a description of the actual behavior of the Federal Reserve System (the Fed) and its interest rate decisions. Specifically, Taylor (1993) proposed the following calibrated specification to guide the Fed and eventually other central banks to decide on the right level of interest rate:

$$i_t = \pi_t + 0.5y_t + 0.5(\pi_t - \pi^*) + 2$$

where i_t denotes the federal funds rate, π_t is the actual inflation rate, π^* is the targeted inflation rate set by Taylor (1993), which is equal to 2, and y_t is a percentage deviation of national income from its full-employment level.

Later, Taylor (1999a) specified a more general rule-based model of US monetary policy:

$$i_t = \pi_t + gy_t + h(\pi_t - \pi^*) + i_t^f$$

where h denotes the responsiveness of the policy rate to the deviation of inflation rate from its target, g is the responsiveness of the policy rate to the output gap, and i_t^f is the central bank's estimate of the equilibrium real interest rate.

Taylor (1999a) stated that a good monetary policy that can stabilize the economy must have significant responsiveness of the interest rate to both inflation and output gaps. Specifically, the inflation rate coefficient must be larger than unity (the Taylor principle) and the output gap coefficient must be positive, preferably 0.5 or higher.

The original Taylor rule has been further developed into various versions. Some integrate the lagged short-run interest rate to count for the interest rate *inertia* (also called the interest rate smoothing). Others use forward-looking or backward-looking versions instead of the simple one-period model to account for central bank policies that may be based on expected or past data to make decisions. However, Taylor (1999b) demonstrated that the simple one-period version of the rule is still more efficient than the aforementioned versions in a sense that the interest rate has lower standard deviations than in other cases. The literature also extends Taylor rule from closed economy to an open economy framework. Clarida et al. (1998) advocated the importance of adding external factors for open economies. Ball (2000) and Svensson (2000) suggested that the Taylor rule should be modified for an open economy by including the exchange rate in the interest rate rule for small open economies.

Many researchers have used the so-called Taylor rule to analyze central banks' monetary policy decisions.⁴ The rule-based description of the actual behavior of central banks

⁴According to Peersman and Smets (1999), some investment banks use Taylor's rule to predict monetary policy decisions.

has been profoundly studied especially in the developed countries. Using a version with interest rate smoothing, Clarida et al. (1998) showed that Taylor rule can explain short-term interest rates in the G-3 countries. Similarly, Gerlach and Schnabel (2000) found that, except for the period of exchange market turmoil in 1992–1993, the simple Taylor rule describes well the monetary policy in the euro area countries in the 1990s. Hofmann and Bogdanova (2012) used the Taylor rule to assess monetary policy stance in both advanced and emerging market economies.

In the case of the developing countries, however, the empirical literature has remained sparse. Especially, the literature on monetary policy rules in MENA countries is rather scarce. In one of a few available papers, Helmi (2011) estimated the monetary policy reaction function using the Taylor rule for inflation targeting countries (Turkey and Israel) and exchange rate targeting countries (Jordan and Morocco). The findings reveal that the central banks in Turkey, Israel, and Morocco focus on stabilizing inflation, whereas the central bank of Jordan focuses on stabilizing the output gap. The author also showed the importance of interest rate smoothing in the decisions on policy rates of all four central banks and the considerable impact of the exchange rate deviation and the foreign interest rate.

Using the forward-looking monetary policy reaction function estimated with quarterly data from 1993 to 2011, Sghaier (2013) showed that the CBT followed the Taylor rule and pointed out the prevalence of inflation over the output as an objective of the monetary policy. Baaziz and Labidi (2016) used quarterly data throughout the period 1998–2013 and investigated how well a nonlinear reaction function of monetary policy can describe the behavior of central banks in Tunisia and Egypt based on the assumption of a non-quadratic loss function. Though the authors demonstrate the existence of a nonlinear policy behavior in these countries, their study does not reject the effectiveness of the simpler linear Taylor rule in illustrating the short-run interest rate setting.

Moursi et al. (2007) estimated a variant of the Taylor-type interest rate feedback rule to the Rotemberg and Woodford (1998) for Egypt from 2001 to the mid-2000s.⁵ They determined a considerable degree of interest rate smoothing, a positive and high output gap coefficient, showing an extreme sensitivity of the interest rate to the real economy fluctuations and a lower than unity coefficient on the inflation gap, implying an ineffective price stabilization policy in Egypt during the study period.

4. Empirical model and data

Based on the literature, we analyze monetary policy rules in the three MENA countries: Tunisia, Egypt, and Morocco, by employing two forms of the contemporary Taylor rule:

- (1) Taylor rule with interest rate smoothing

$$i_t = \alpha + \rho i_{t-1} + (1 - \rho)\{\beta y_t + \gamma(\pi_t - \pi^*)\} + \varepsilon_t \quad (1)$$

- (2) Open economy Taylor rule with interest rate smoothing

$$i_t = \alpha + \rho i_{t-1} + (1 - \rho)\{\beta y_t + \gamma(\pi_t - \pi^*) + \delta z_t\} + \varepsilon_t \quad (2)$$

where i_t , α , y_t , π_t , π^* , and z_t denote each country nominal interest rate, long-run target level of nominal interest rate (the constant term; $\alpha = r^* + \pi^*$), output gap, inflation

⁵The authors use the overnight interbank rate as a representative of the central bank policy rate.

rate, (constant) target inflation rate, and change in the exchange rate, respectively. ε_t is an error term—deviation of interest rate from the estimated rule.

The output gap is estimated as the difference between the logarithms of industrial production of each country and the potential output estimated using the Hodrick-Prescott filter on the logarithm of industrial production. The inflation gap is the difference between year-on-year inflation rate and inflation target calculated as the sample period average year-on-year inflation rate.⁶ The choice of period average inflation as an inflation target follows Bunzel and Enders (2010). We consider such a choice credible and acceptable because the long-run average inflation can be considered an implicit target that central banks try to converge to. It might be especially so in the case of the countries under our analysis because they speak of their intention to implement a target inflation framework since the early 2000s but have not done so. Change in the exchange rate is a log-difference of the trade-weighted nominal exchange rate index (NEER) for each country.

We estimate coefficients of the Taylor rules using Ordinary Least Squares (OLS) regressions with Newey–West standard errors that assume the error structure being heteroskedastic and possibly autocorrelated. In choosing OLS estimation, we follow Carvalho et al. (2019), who found that the endogeneity bias in Taylor rule is small and argued in favor of OLS estimation of policy rules. Further, as a robustness check, we enrich our methodology using the GMM method, which numerous studies also employed. However, the problem of this methodology might be the fact that finding suitable instruments can be challenging, as their validity depends on details of the economic environment other than the policy rule to be estimated (Carvalho et al., 2019).

Data used in the analysis are of monthly frequency. Each country's industrial production, exchange rate, and consumer price index (CPI) data come from IMF IFS and World Bank databases. We take the logarithm of industrial production and exchange rate to calculate output gap and exchange rate change, respectively, and use CPI data to calculate year-on-year inflation rates used to compute the inflation gap. Interest rate data come from various sources. For Egypt, an overnight interbank interest rate from DataStream is used. Morocco's money market rate is taken from IMF IFS database. For Tunisia, the rate of the money market–TMM comes from CBT. The use of the ex-post revised data rather than real-time data available to the policymakers at the time of the decision is driven by the lack of available real-time data for the three countries under analysis. Figure 2 presents the variables used for empirical analysis.

Estimations based on time series data require tests for data stationarity. The results of the ADF, Phillips–Perron, and KPSS tests are reported in Appendix. They provide ambiguous evidence on the stationarity of the variables. In the full sample, the interest rate in all countries and the inflation gap in Egypt seems non-stationary, whereas other variables do not seem to have a unit root. In the subsamples, the three tests for stationarity tend to disagree on whether some variables are stationary or not. As Selim (2012) observed, empirical papers using reaction functions often ignore the unit roots in the data, given the lower power of the DF test in short samples; Gerlach-Kristen (2003) also

⁶During each sample country's period of study that all end by 2017 none of the central banks, in Tunisia, Egypt or Morocco, has announced to the public any target level of the inflation rate. However, it is worthwhile to mention that the central banks of Tunisia and Egypt intend to implement in the future a formal Inflation Targeting Regime once the fundamental prerequisites are met.

pointed out that stationarity is more likely rejected over samples shorter than 20 years. Thus, we follow previous papers that used Taylor rules without considering the stationarity of the data (e.g. Taylor, 1999a; Gerlach & Schnabel, 2000; Clarida et al., 1998, 2000; Hofmann & Bogdanova, 2012; Nelson, 2000; Peersman & Smets, 1999; Orphanides, 2001; Rudebusch, 2002) and proceed with our assumption that all variables are stationary and that the mixed results are due to low power of the unit root tests. Note that in this paper, we aim to test whether the rule proposed by Taylor's (1993) theory is applied by the central banks under concern, especially in the aftermath of the institutional reforms that followed the tremors of the Arab Spring that shocked our sample countries.

Sample periods depend on data availability and begin in January 2007 for Egypt and Morocco, and in January 2000 in case of Tunisia. Samples end in December 2017 for the countries. We also divide the sample periods into pre- and post-Arab Spring periods using the Wald test for a structural break at unknown break date that allows us to identify the date at which the data development point at a significant change in their structure. Because pinpointing the changes caused by the Arab Spring to a specific date is difficult, instead of choosing the breakpoint arbitrarily, we base the choice on the data and statistical tests instead. The details on the procedure and Wald test results are in Appendix.

5. Results of the linear model

This section describes the results of the estimation of the Taylor rules presented in Section 4. We investigate whether policy rates of central banks in Tunisia, Egypt, and Morocco can be described by a rule that is as a linear combination of several variables, including inflation and output deviations from their respective long-run levels, and if so, what are the weights of these two fundamentals in the interest rate setting. We also investigate the extent of interest rate smoothing and responsiveness of interest rates to exchange rate changes. Finally, we check whether and if so, how the period of transition influences the implementation of the monetary policy in the three countries.

First, we carry out model autocorrelation checks via Breusch–Godfrey LM test.⁷ Table 1 holds the results for each country, the two types of Taylor rules, and all the considered sample periods (to be explained in detail in each country sub-section) for a few chosen lag orders. In the case of the full-sample model for Tunisia and most models for Egypt and Morocco, the Breusch–Godfrey test rejects the null hypothesis of no autocorrelation of the error terms. The autocorrelation seems particularly strong in Morocco—the full sample and the first sub-sample and also for the full-sample Egyptian model. Although autocorrelation is a rather common problem in analyzing time series data, the consideration of the Breusch–Godfrey test results already provides us some insight into the fit of the Taylor rule model to each country's data. In the case of Tunisia, the data seem to fit the Taylor rule rather well. However, the cases of Egypt and especially Morocco are more problematic, where we observe strong and lasting autocorrelation in the full sample model and to only a slightly smaller extent in the first sub-sample. We will come back to these observations, while analyzing the results of the estimation.

⁷Durbin's alternative test for serial correlation shows qualitatively the same results

Table 1. Autocorrelation analysis.

Country and model	Sample	Breusch-Godfrey LM test					
		1 lag	3 lags	6 lags	12 lags	18 lags	24 lags
Tunisia Interest rate smoothing	Full sample	5.695 (0.017)	12.746 (0.005)	13.370 (0.038)	16.921 (0.153)	25.137 (0.121)	31.118 (0.150)
	Earlier period	0.009 (0.926)	5.027 (0.170)	5.222 (0.516)	7.467 (0.825)	11.941 (0.850)	18.945 (0.755)
	Transition period	2.567 (0.109)	4.125 (0.248)	4.527 (0.606)	8.501 (0.745)	13.149 (0.783)	18.096 (0.798)
Tunisia Open economy	Full sample	4.629 (0.031)	10.451 (0.015)	12.861 (0.045)	15.796 (0.201)	22.932 (0.193)	30.747 (0.161)
	Earlier period	0.003 (0.957)	4.944 (0.176)	5.051 (0.537)	7.196 (0.844)	11.865 (0.854)	18.655 (0.770)
	Transition period	0.970 (0.325)	1.386 (0.709)	2.705 (0.845)	6.132 (0.909)	12.953 (0.794)	18.366 (0.785)
Egypt Interest rate smoothing	Full sample	0.187 (0.665)	2.114 (0.549)	3.725 (0.714)	30.284 (0.003)	34.100 (0.012)	36.648 (0.047)
	Earlier period	0.527 (0.468)	11.368 (0.010)	12.523 (0.051)	13.931 (0.305)	16.384 (0.566)	25.855 (0.361)
	Transition period	0.085 (0.771)	2.885 (0.410)	4.602 (0.596)	25.837 (0.013)	30.832 (0.030)	36.431 (0.050)
Egypt Open economy	Full sample	0.376 (0.539)	4.608 (0.203)	7.688 (0.262)	11.419 (0.493)	14.186 (0.717)	16.147 (0.883)
	Earlier period	0.544 (0.461)	11.300 (0.010)	12.467 (0.052)	14.100 (0.294)	15.779 (0.608)	23.831 (0.471)
	Transition period	0.191 (0.662)	6.306 (0.098)	7.557 (0.272)	11.165 (0.515)	14.447 (0.670)	17.767 (0.814)
Morocco Interest rate smoothing	Full sample	0.209 (0.648)	15.897 (0.001)	21.039 (0.002)	29.115 (0.004)	39.239 (0.003)	43.089 (0.010)
	Earlier period	0.120 (0.729)	9.214 (0.027)	13.809 (0.032)	24.544 (0.017)	28.199 (0.059)	30.322 (0.174)
	Transition period	6.392 (0.012)	8.074 (0.045)	9.438 (0.150)	12.082 (0.439)	13.995 (0.729)	17.194 (0.840)
Morocco Open economy	Full sample	0.070 (0.792)	16.380 (0.001)	21.993 (0.001)	30.506 (0.002)	39.687 (0.002)	43.655 (0.008)
	Earlier period	0.036 (0.850)	8.307 (0.040)	13.130 (0.041)	25.102 (0.014)	27.817 (0.065)	29.513 (0.201)
	Transition period	5.592 (0.018)	7.523 (0.057)	9.777 (0.134)	12.839 (0.381)	14.787 (0.677)	17.042 (0.847)

Note: Breusch-Godfrey LM test – chi squared statistic and p -value in brackets, null hypothesis: no autocorrelation.

5.1. Tunisia

The top of Table 2 provides the estimation results for the two types of Taylor rules for Tunisia, based on the data from 2000 to 2017. The sample period is also divided into two sub-periods as given by the structural break test at an unknown breakpoint. The Wald test reveals a structural break in August 2011—few months after the Arab Spring started, thus confirming our supposition on the possible change in monetary policy setting due to the political transition toward a new regime in Tunisia. We call the period before this breakpoint the *earlier period* and the period after, the *period of transition*.

The results of the estimation of the interest rate smoothing and the open economy versions of the Taylor rule provide strong evidence in favor of the interest rate *inertia* in Tunisia. This inertia is remarkable whether during the whole period of study or within the two sub-periods. All other things being equal, the lagged interest rate alone explains more than 98% of the current interest rate, and its importance does not change

Table 2. The reaction function models of the short-run interest rate.

Tunisia						
Samples	2000m1–2011m7		2011m8–2017m12		2000m1–2017m12	
	Smoothing	Open economy	Smoothing	Open economy	Smoothing	Open economy
<i>Lagged interest rate</i>	0.983*** (0.018)	0.983*** (0.018)	0.952*** (0.035)	0.960*** (0.033)	0.988*** (0.019)	0.992*** (0.019)
<i>Output gap</i>	0.461** (0.224)	0.453* (0.230)	-0.390 (1.129)	-0.539 (1.088)	0.271 (0.250)	0.318 (0.249)
<i>Inflation gap</i>	0.002 (0.007)	0.002 (0.007)	0.063*** (0.021)	0.064*** (0.020)	0.014 (0.008)	0.014* (0.008)
<i>Exchange rate change</i>		0.004 (0.013)		-0.044*** (0.013)		-0.032*** (0.011)
<i>constant</i>	0.074 (0.095)	0.075 (0.095)	0.170 (0.160)	0.111 (0.152)	0.056 (0.097)	0.024 (0.098)
<i>N</i>	127	127	77	77	204	204
<i>F</i>	1103.94	825.08	442.68	350.39	1252.27	922.10
<i>(P value)</i>	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>R-squared</i>	0.968	0.968	0.935	0.949	0.967	0.970
<i>Adj. R-squared</i>	0.9675	0.967	0.933	0.946	0.9665	0.969
<i>Lag</i>	0	0	0	0	9	9
Egypt						
	2007m1–2011m10		2011m11–2017m12		2007m1–2017m12	
	Smoothing	Open economy	Smoothing	Open economy	Smoothing	Open economy
<i>Lagged interest rate</i>	0.832*** (0.042)	0.828*** (0.043)	0.893*** (0.044)	0.889*** (0.047)	0.951*** (0.023)	0.940*** (0.021)
<i>Output gap</i>	-0.513 (1.203)	-0.674 (1.262)	1.325 (2.716)	2.699 (2.146)	-0.543 (1.823)	0.499 (1.239)
<i>Inflation gap</i>	0.060*** (0.016)	0.058*** (0.016)	0.065*** (0.020)	0.061** (0.024)	0.043*** (0.015)	0.043*** (0.012)
<i>Exchange rate change</i>		0.014 (0.021)		-0.048*** (0.006)		-0.047*** (0.011)
<i>constant</i>	1.418*** (0.380)	1.456*** (0.393)	1.138** (0.462)	1.169** (0.479)	0.470** (0.222)	0.545*** (0.195)
<i>N</i>	57	57	74	74	131	131
<i>F</i>	285.04	241.13	2632.59	923.56	6135.59	625.31
<i>(P value)</i>	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>R-squared</i>	0.938	0.939	0.969	0.979	0.968	0.976
<i>Adj. R-squared</i>	0.935	0.933	0.967	0.978	0.967	0.9755
<i>Lag</i>	7	7	24	3	24	0
Morocco						
	2007m1–2012m2		2012m3–2017m12		2007m1–2017m12	
	Smoothing	Open economy	Smoothing	Open economy	Smoothing	Open economy
<i>Lagged interest rate</i>	0.549*** (0.049)	0.541*** (0.052)	0.984*** (0.020)	0.982*** (0.020)	0.961*** (0.032)	0.962*** (0.033)
<i>Output gap</i>	-0.274 (0.814)	-0.304 (0.816)	1.957** (0.935)	1.951** (0.878)	0.751 (0.770)	0.761 (0.782)
<i>Inflation gap</i>	0.009 (0.006)	0.009 (0.007)	0.005 (0.006)	0.003 (0.006)	0.007 (0.008)	0.006 (0.009)
<i>Exchange rate change</i>		0.033*** (0.006)		0.023 (0.019)		0.024*** (0.014)
<i>constant</i>	1.495*** (0.163)	1.523*** (0.174)	0.033 (0.054)	0.035 (0.053)	0.113 (0.103)	0.111 (0.106)
<i>N</i>	62	62	72	72	134	134
<i>F</i>	49.08	39.06	898.46	747.6	759.86	592.70
<i>(P value)</i>	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>R-squared</i>	0.396	0.420	0.981	0.982	0.922	0.924
<i>Adj. R-squared</i>	0.362	0.380	0.981	0.981	0.921	0.921
<i>Lag</i>	21	20	4	4	24	24

Notes: *, ** and *** indicate significant at 10%, 5% and 1%, respectively. Numbers in parentheses are the standard errors of the OLS coefficient estimates with Newey-West standard errors. Lag indicates lag order for Newey-West standard errors. The structural break point dates are based on Wald Test.

remarkably during the period of transition. Obviously, Tunisian central bank is greatly concerned about avoiding large-scale changes when making decisions on the new level of policy rates.

However, estimation results of the two Taylor rule models on the full sample data provide only weak evidence in favor of a rule-based monetary policy in Tunisia during the period between 2000 and 2017. The inflation gap coefficients are positive but either non-significant or weakly significant, and the output gap coefficients are positive and statistically not significant.

However, the open economy reaction function shows that from 2000 to 2017, the CBT's policy rate seems to react to the change in the nominal exchange rate. In accordance with the theory, the appreciation of domestic currency leads to interest rate cuts.

A comparison of the two subsamples reveals a considerable change in monetary policy decision-making in Tunisia. First, both rules show that the sensitivity of the short-run interest rate to inflation deviations is positive and statistically significant in the period of transition, implying that CBT is relatively more active in efforts to stabilize prices and drive the inflation rate back to its long-run level during this time.

Second, it seems that the CBT stance toward business cycle stabilization has also changed, though in the opposite direction toward passive policy: the response of the short-run interest rate to a marginal change in the output gap becomes negative and no longer statistically significant in smoothing and open economy rules.

Finally, the nominal exchange rate fluctuations have become an important element in shaping a monetary policy in Tunisia after 2011. The coefficient of exchange rate change becomes significantly negative in the transition period. This might be associated with a shift in exchange rate regime toward more flexible form. Nevertheless, even in such a case this result might look, a priori, strange because the capital account is not fully liberalized in Tunisia, and strict control over capital movements is still taking place. Hence, any change in policy rates is highly unlikely to be aimed at stabilizing the value of the Tunisian dinar against principal foreign currencies. This is because the interest rate in Tunisia practically plays a minor role in attracting foreign capital flows. However, this result can be comprehensible if we interpret the exchange rate as an important determinant of inflation. By enhancing its reaction to the nominal exchange rate, CBT might try pre-emptively limiting its impact on future prices. It is especially plausible when we observe that the Tunisian dinar has been under continuous depreciating pressure during the transition (panel B in [Figure 2](#)).

The three aforementioned differences show that the period of political transition has brought a remarkable evolution in CBT's monetary policy setting. A significant change is observed in the weights of the macroeconomic fundamentals to which the short-term nominal interest rate reacts. Clearly, the political, economic, and social pressures that featured the period of transition have made the CBT more vigilant and responsive to any upward movement in the price level instead of focusing on the output.

Still, we cannot say that CBT fully commits to any rule during the study period. Even though the results point at the responsiveness of the central bank policy to certain fundamentals, this responsiveness remains weak or is non-existent for the others, notably output. Nonetheless, the signs of an evolution of the monetary policy in Tunisia toward a rule-based guide with a stronger emphasis on inflation are clear, though time is still needed to qualify such a change as a commitment to a policy rule on the part of the central bank.

5.2. Egypt

The middle part of [Table 2](#) shows the results of the estimation of the two types of reaction functions for the short-run interest rate for Egypt, based on data going from 2007 to 2017. As in the case of Tunisia, the sample period is divided into two sub-periods in November 2011 as given by the structural break test at an unknown breakpoint. Recall that in February 2011 Egypt experienced a popular uprising as an event in the domino effect initiated by the Tunisian revolution a few months before. Hence, the estimated date of structural break matches the major political and social events that struck Egypt at the time and support our aim to study the changes in monetary policy setting due to political and social transition. Accordingly, we define the sub-period that starts from November 2011 as the *transition period* because it corresponds to the establishment of a new political regime with the accompanying risks that this process brings with it.

The estimation results of the smoothing and open economy models during the entire period of study and both sub-periods point out that, as in Tunisia, strong *inertia* of the interest rate-setting exists. The coefficient of the lagged interest rate is positive and highly statistically significant in all estimated models, showing a strong willingness on the part of CBE to preserve interest rate stability.

The full sample model results show that the output gap coefficient is not statistically significant, whereas the coefficient on the inflation gap is positive and statistically significant, although rather weak. The introduction of the change in the nominal exchange rate (NEER) to the Taylor rule also shows some responsiveness on the part of the CBE to deviations in the exchange rate—the corresponding coefficient is negative, as in the case of Tunisia.

A comparison of the two subsamples shows a slight shift toward an interest rate stability policy and almost no change in policy responsiveness to the macroeconomic fundamentals—i.e. the output gap and the inflation gap. During both periods, besides the lagged interest rate, the CBE rate reacts, though only very slightly, to the inflation gap variable for which the coefficient is positive and statistically significant. The magnitude of the response did not exhibit any change. Thus, we can say that in the transition period, the CBE policy kept being weakly effective in stabilizing the real economy and current prices.

Further, even though we can observe some responsiveness of the central bank to exchange rate changes during the period of transition, it seems to have been insufficient in a period when the country shifted to a more flexible exchange rate regime in this period and the Egyptian pound depreciated, with especially sharp fall in November 2016 (panel B in [Figure 2](#)). The CBE's policy has been too weak toward this large weakening of the national currency, failing thus, to pre-emptively control its impact on future prices; the claim supported by a huge spike in prices throughout this sub-period, when, by the end of 2016, the inflation rate climbed up to more than 17% a year (the highest in eight years; see panel C in [Figure 2](#)).

Overall, we can observe from both sub-periods that the monetary policy decision-making in Egypt can hardly be described as committing to any rule. Monetary policy guideline in Egypt in the years 2007–2017, and even in the post-Arab spring period from 2012, is still not well-formulated with rather discretionary policy in place.

5.3. Morocco

The results of the estimation for Morocco are shown in the bottom part of [Table 2](#). The full-sample estimations are based on the data from 2007 to 2017. The Wald test of a structural break at an unknown date point in March 2012 as a structural break date. Morocco was also hit by the escalating events of the Arab uprising domino effects that initiated in nearby Tunisia. Although there was no total collapse of the regime, the voters approved several reforms to the monarchy constitution in a referendum that took place in 2011. This movement handed several rights from the monarch to the prime minister and the elected parliament.

The results of the estimation reveal that during the whole period of study, the monetary policy of BAM is not based on either Taylor rule version. This is because, in clear contrast with the theory, both output and inflation gaps' coefficients are positive but statistically non-significant, and the coefficient of the exchange rate change is significant but positive. Like in Tunisia and Egypt, setting the actual short-run interest rate in Morocco has a strong *inertia* throughout the whole sample period generally, and the period of transition outstandingly.

During each sub-period, the results of the estimation show that the BAM is also not following, nor even being close to apply, an interest rate setting based on either version of the Taylor rule. The results show, however, some important changes in the policy set during the transition period. First, the extent of smoothing changes greatly between the two sub-periods. The coefficient of the lagged interest rate is more than double in the period of transition, pointing to the much greater commitment of the central bank to keep stable the level of interest rate and avoid large-scale changes in a short time.

Second, an increase in the sensitivity of the short-term nominal interest rate to the output gap seems to be taking place: in the transition period, the coefficient is substantially higher and becomes statistically significant. In recent years, the objective of business-cycle stabilization in the policy setting of the BAM has been of growing importance. At the same time, however, we cannot observe any increase in interest in inflation stabilization. In the open economy model, the coefficient of the change in the nominal exchange rate stays positive but is no longer statistically significant in the latter period, implying little importance of exchange rate stabilization. Overall, the results of the analysis provide little evidence of a remarkable evolution of the BAM toward rule-based decision-making in monetary policy.

As mentioned at the beginning of this section, examining the model error terms uncovers large autocorrelation orders for Morocco ([Table 1](#)). Meanwhile, this autocorrelation order decreases substantially when only the period of transition is examined. Together with the adjusted coefficients of determination of the models, which improved remarkably,⁸ and the estimated coefficients, this finding reveals that the Taylor rule models start to fit rather well with the data and consequently describe the monetary policy in Morocco relatively well, only since 2012, i.e. the beginning of the period of transition.

⁸The adjusted R-squared passes from around 36% in the earlier period's model estimations to more than 98% in the period of transition (see [Table 2](#)).

The results of the estimation of the models show some policy turn toward business cycle stabilization and much more stable interest rate setting in the form of interest rate inertia in the period of transition. Nevertheless, the monetary policy stays mute toward other macroeconomic variables, i.e. the inflation gap and the exchange rate change. Thus, on the whole, the monetary policy in Morocco during the study periods can still be described as rather discretionary and solely related to the recent developments in the economy.

In summary, the estimation results reveal no sufficiently reliable proof backing the claim of a Taylor rule-based monetary policy in the three MENA countries being studied: Tunisia, Egypt, and Morocco. The policy rate in these countries is principally based on the willingness of the monetary authorities to preserve the stability of interest rates. In fact, during several study periods, a sustainable responsiveness of central banks' policy rate to the output and inflation gaps or even the exchange rate changes have no strong evidence.

This weak connection between the interest rate and the inflation gap can be attributed in a certain extent to government budget concerns that the sample countries had to cope with, especially during the Arab Spring period when popular uprisings for economic and social demands were frequent. The budget pressures were intensified by the increasing volatility of the energy prices in international markets, given that energy subsidies represent an important government expense in the MENA region. Dealing with such budgetary pressures might have affected the monetary autonomy. [Figure 1](#) shows that after the Global Financial Crisis of 2008, the fiscal deficit in Tunisia, Egypt, and Morocco has remarkably increased. This soaring in public deficits has significantly intensified after 2011, the year of the Arab Spring commencement.

5.4. Robustness check

To check the robustness of our results, we present in [Table 3](#) the results of the Taylor rule estimations based on GMM regressions, for the three countries, where we also control for autoregression and check for the endogeneity of the model. First, we observe that our models have no endogeneity problems; thus, our choice of OLS estimation as a more efficient model is justified. Further, the results of the estimation are qualitatively similar to the benchmark estimations—they show similar changes in the statistical significance of the parameters. We can thus confirm the regime change during the periods of transition toward more rule-based policymaking in Tunisia and Morocco, with increased sensitivity of short-term interest rate to inflation gap in the former and to output gap in case of the latter country, and toward strong interest rate smoothing in Egypt.

In the following section, we will investigate the potential occurrence of an opportunistic monetary policy on the part of the three central banks during the different sub-periods.

6. Is there *opportunism* in conducting monetary policies?

Having confirmed the impact of economic and political transition on the central bank decision-making in the three countries under interest, in this section, we use the threshold model to investigate the possibility of an opportunistic monetary policy on

Table 3. GMM model results together with endogeneity tests.

	Tunisia					
	2000–2011m7		2011m8–2017		2000–2017	
	Smoothing	Open economy	Smoothing	Open economy	Smoothing	Open economy
<i>Lagged interest rate</i>	0.973*** (0.020)	0.939*** (0.217)	0.931*** (0.053)	0.940*** (0.032)	0.976*** (0.013)	0.983*** (0.016)
<i>Output gap</i>	0.921* (0.496)	2.478 (9.957)	−0.514 (2.361)	−0.151 (1.932)	0.598 (0.379)	0.791* (0.482)
<i>Inflation gap</i>	−0.002 (0.012)	−0.022 (0.132)	0.076** (0.032)	0.085*** (0.030)	0.011 (0.009)	0.010 (0.009)
<i>Exchange rate change</i>		−0.382 (2.173)		−0.072 (0.045)		−0.061* (0.031)
<i>constant</i>	0.121 (0.988)	0.183 (0.485)	0.245 (0.220)	0.163 (0.137)	0.115* (0.060)	0.059 (0.082)
<i>N</i>	126	126	77	77	203	203
<i>Wald chi2</i> (<i>P value</i>)	5242.13 (0.000)	958.22 (0.000)	2468.18 (0.000)	3249.99 (0.000)	6935.41 (0.000)	6683.1 (0.000)
<i>R-squared</i>	0.967	0.780	0.935	0.942	0.966	0.967
<i>Endogeneity test (p-value)</i>	2.344 (0.504)	4.410 (0.353)	1.862 (0.602)	2.834 (0.586)	2.383 (0.497)	2.367 (0.671)
	Egypt					
	2007 – 2011m10		2011m11 – 2017		2007 – 2017	
	Smoothing	Open economy	Smoothing	Open economy	Smoothing	Open economy
<i>Lagged interest rate</i>	0.845*** (0.042)	0.864*** (0.071)	0.970*** (0.051)	0.998*** (0.080)	0.982*** (0.031)	0.994*** (0.044)
<i>Output gap</i>	1.093* (0.657)	2.283 (1.985)	0.464 (4.356)	−0.440 (5.825)	0.198 (1.991)	−0.334 (2.459)
<i>Inflation gap</i>	0.059*** (0.015)	0.085*** (0.032)	0.027 (0.021)	0.017 (0.030)	0.024* (0.014)	0.020 (0.017)
<i>Exchange rate change</i>		−0.176 (0.193)		0.028 (0.025)		0.019 (0.028)
<i>constant</i>	1.290*** (0.378)	1.030 (0.678)	0.399 (0.464)	0.156 (0.708)	0.202 (0.262)	0.111 (0.346)
<i>N</i>	56	56	74	74	130	130
<i>Wald chi2</i> (<i>P value</i>)	1461.71 (0.000)	885.49 (0.000)	6712.15 (0.000)	8231.36 (0.000)	6949.10 (0.000)	11993.12 (0.000)
<i>R-squared</i>	0.941	0.887	0.968	0.952	0.968	0.960

Endogeneity test (<i>p</i> -value)	1.852 (0.604)	2.737 (0.603)	2.323 (0.508)	1.649 (0.800)	2.865 (0.413)	3.800 (0.434)
Morocco						
	2007 – 2012m2		2012m3 – 2017		2007 – 2017	
	Smoothing	Open economy	Smoothing	Open economy	Smoothing	Open economy
<i>Lagged interest rate</i>	0.155 (0.191)	0.165 (0.176)	0.977*** (0.013)	0.968*** (0.015)	0.965*** (0.023)	0.973*** (0.027)
<i>Output gap</i>	-0.322 (1.610)	-0.330 (1.694)	1.103 (0.869)	0.912 (1.038)	0.462 (0.874)	0.498 (1.013)
<i>Inflation gap</i>	0.025* (0.014)	0.022 (0.018)	0.014* (0.008)	-0.001 (0.021)	0.012 (0.009)	0.004 (0.010)
<i>Exchange rate change</i>		0.039* (0.022)		0.104 (0.102)		0.109*** (0.037)
<i>constant</i>	2.808*** (0.633)	2.776*** (0.585)	0.055 (0.035)	0.067*** (0.032)	0.100 (0.072)	0.073 (0.081)
<i>N</i>	60	60	70	70	130	130
<i>Wald chi2</i> (<i>P</i> value)	9.00 (0.029)	8.08 (0.089)	7563.95 (0.000)	8150.91 (0.000)	2250.28 (0.000)	2179.11 (0.000)
<i>R-squared</i>	0.141	0.192	0.980	0.974	0.920	0.904
<i>dogeneity test (p-value)</i>	2.522 (0.471)	2.585 (0.630)	5.472 (0.140)	4.617 (0.329)	1.544 (0.672)	3.852 (0.426)

Notes: *, ** and *** indicate significant at 10%, 5% and 1%, respectively. Endogeneity test: null hypothesis is of variables being exogenous.

the part of the central banks of Tunisia, Egypt, and Morocco. The threshold model helps explore the possibility that central banks react differently to inflation depending on the state of the economy. In fact, the responsiveness of monetary authorities is expected to intensify when the inflation is high. The evidence of structural breaks given in the previous section supports the existence of parameter instability in the linear Taylor rule. This finding leads us to investigate monetary policy rules in more detail. For that, we use the threshold version of Taylor rule introduced by Bunzel and Enders (2010), who stated that central banks might carry out an opportunistic monetary policy and react differently to output and inflation changes depending on the level of the targeted variables. As put in other words by the authors, *opportunism* suggests that central banks target an intermediate inflation rate that can be gradually decreased over time. Therefore, a central bank following an opportunistic strategy would wait for favorable price surprises to reduce inflation instead of taking deliberate actions (Rudebusch, 1996).

We follow the same methodology as Bunzel and Enders (2010), who used the following threshold model:

$$i_t = (\alpha_0 + \alpha_1 \pi_t + \alpha_2 y_t + \alpha_3 z_t + \alpha_4 i_{t-1}) I_t + (1 - I_t)(\beta_0 + \beta_1 \pi_t + \beta_2 y_t + \beta_3 z_t + \beta_4 i_{t-1}) + \varepsilon_t \quad (4)$$

where I_t is the Heaviside indicator. $I_t = 1$ if $x_{t-d} < \tau$ and $I_t = 0$ otherwise, where x_{t-d} is a threshold variable, τ is the threshold level, and the subscript d is a lag.

In this methodology, we allow the threshold variable to be time-varying such that

$$I_t = 1 \text{ if } \pi_{t-1} < \pi_{t-1}^* \text{ and } I_t = 0 \text{ otherwise}$$

where π_{t-1}^* is the interim target for the period $t - 1$.

According to Bomfim and Rudebusch (2000), the interim target should depend on the long-run target value of inflation and past 'inherited inflation'. Based on this definition, we choose the average quarterly inflation rate in the previous year as an intermediate target. Hence, to investigate any possible opportunistic monetary policy among our sample countries, we estimate the model in Equation (4) such that the Heaviside indicator follows:

$$I_t = 1 \text{ if } \bar{\pi}_{j-1} < \bar{\pi}_{j-5} \text{ and } I_t = 0 \text{ otherwise.}$$

where j is a subscript referring to the current quarter, such as $j \in [t, t + 1, t + 2], j + 1 \in [t + 3, t + 4, t + 5]$, and so on, and $\bar{\pi}_{j-1} = \left(\frac{\pi_{t-1} + \pi_{t-2} + \pi_{t-3}}{3} \right)$ and $\bar{\pi}_{j-5} = \left(\frac{\pi_{t-13} + \pi_{t-14} + \pi_{t-15}}{3} \right)$ are the quarterly averages of the inflation rate prevailing in the previous quarter, $(j - 1)$, and the previous year, $(j - 5)$, respectively.

The quarterly inflation rate in the previous year serves as a threshold that can decline over time as inflation declines. Hence, the central banks are expected to react more aggressively as long as the current inflation rate exceeds the average inflation rate one year prior. Otherwise, they would stay in a relatively inactive state.⁹

Table 4 reports the results of the opportunistic model for Tunisia, Egypt, and Morocco. The results provide evidence of opportunistic behavior in the monetary policy conducted

⁹Another statistical advantage of this model is that the threshold variable $\bar{\pi}_{j-1} < \bar{\pi}_{j-5}$ is stationary, which gives the model better properties than conditioning it on a non-stationary variable.

Table 4. Opportunistic models.

Start	End	Lagged interest rate		Inflation rate		Output gap		Exchange rate change		Intercept		F	R-squared Adjusted	N	
Tunisia															
2000:1	2017:12	α_4 0.965*** (0.029)	β_4 0.996*** (0.017)	α_1 0.002 (0.016)	β_1 0.022* (0.012)	α_2 0.741* (0.376)	β_2 -0.257 (0.346)	α_3 -0.020* (0.011)	β_3 -0.050*** (0.012)	α_0 0.132 (0.169)	β_0 -0.089 (0.112)	653.7***	0.97	regime: $\bar{\pi}_{j-1} < \bar{\pi}_{j-5}$ 84	regime: $\bar{\pi}_{j-1} > \bar{\pi}_{j-5}$ 112
Egypt															
2007:2	2018:4	α_4 0.938*** (0.024)	β_4 0.923*** (0.031)	α_1 0.003 (0.025)	β_1 0.053*** (0.015)	α_2 -1.925 (1.604)	β_2 0.668 (1.219)	α_3 0.015 (0.036)	β_3 -0.050*** (0.007)	α_0 0.579** (0.263)	β_0 0.152 (0.193)	742.9***	0.98	regime: $\bar{\pi}_{j-1} < \bar{\pi}_{j-5}$ 63	regime: $\bar{\pi}_{j-1} > \bar{\pi}_{j-5}$ 72
Morocco															
2001:2	2018:2	α_4 0.796*** (0.067)	β_4 0.720*** (0.055)	α_1 0.006 (0.026)	β_1 -0.005 (0.022)	α_2 2.017 (2.022)	β_2 -1.017 (2.178)	α_3 0.024 (0.039)	β_3 -0.073 (0.080)	α_0 0.570*** (0.199)	β_0 0.824*** (0.173)	37.5***	0.62	regime: $\bar{\pi}_{j-1} < \bar{\pi}_{j-5}$ 95	regime: $\bar{\pi}_{j-1} > \bar{\pi}_{j-5}$ 103

Notes: *, ** and *** indicate significant at 10%, 5% and 1% respectively. Numbers in parentheses are the standard errors of the coefficient OLS estimates.

by the CBT from 2000 to 2017. As shown by the positive and statistically significant coefficient β_1 , the responsiveness of the policy rate to the current inflation rate becomes stronger when the average rate of inflation during the last quarter exceeds last year's average. Further, the coefficient of the NEER change becomes larger in absolute terms and more strongly significant, pointing at the increased aggressiveness of CBT's monetary policy toward the exchange rate, which might influence future inflation, as explained in Section 5.1. Meanwhile, the positive and significant coefficient α_2 shows that when the inflation rate is below the interim target and therefore under control, the CBT's attention goes to the real economy, and the interest rate changes to stabilize its fluctuations.

The results for Egypt are largely similar to Tunisia's; in fact, during the period of study from February 2007–2017, and as mentioned by the positive and highly significant coefficient β_1 , the central bank's monetary policy became more aggressive toward the current inflation rate when the average inflation rate in the previous quarter exceeds the interim target, that is, the previous year's quarterly average of the inflation rate. When the interim target has surpassed the responsiveness of the CBE to current inflation is even stronger than CBT's. Further, the negative and statistically significant coefficient on NEER change (β_3) confirms the intensification of the CBE policy responsiveness to exchange rate fluctuations, which again might be a trigger for future inflation. Notice that the central banks of both Tunisia and Egypt become clearly more attentive to prospective increases in prices when the interim target of inflation is surpassed; in fact, the magnitude of their policy responsiveness to exchange rate changes is almost the same as indicated by almost equal coefficients (β_3) for both countries.

With regard to Morocco, the empirical estimations do not provide any evidence of an inflation-based opportunistic strategy by the BAM during the period from January 2007 to February 2018. As revealed by the statistically non-significant inflation rate coefficients, α_1 and β_1 , the Moroccan central bank's reaction to the current inflation does not seem to switch to a more aggressive response when the recent quarterly average rate of inflation exceeds last year's corresponding rate. The same can be said about the policy responses to output gap deviations and exchange rate changes. To a certain extent, this finding supports the largely passive monetary policy on the part of BAM demonstrated in the previous section.

Thus, the threshold model estimations imply opportunistic behavior on the part of the Tunisian and Egyptian central banks, aiming to lower the inflation rate when it exceeds a certain time-varying threshold level. They also confirm the heightened interest of the central banks in stabilizing inflation, either directly or indirectly, through the reaction to exchange rate fluctuations, which we noted in Section 5.

7. Conclusions and implications

In this paper, we base on the Taylor rule framework to evaluate the monetary policy setting in the three MENA countries: Tunisia, Egypt, and Morocco. With the full-sample estimations, we also compare results of the pre- and post-Arab Spring periods to assess the impact of the political transition process these countries experienced on the behavior of the central bank.

The main results show that evidence in favor of a monetary policy based on rules is rather weak and central banks in these countries still rely to a large extent on discretion and the

interest rate smoothing in setting their short-term interest rates. Simultaneously, however, some turns are observed toward more rule-based monetary policy settings in Tunisia and Morocco in the period following the so-called Arab Spring, with these countries focusing more on price and business cycle stabilization, respectively. However, it is too early to assert this claim because this new turn needs to be sustained over time to be confirmed.

Further, Tunisia and Egypt show growing interest rate sensitivity toward the exchange rate during uncertainties. Although these countries have not yet fully liberalized its capital account, we can observe an increase in their responsiveness to the exchange rate, which might contain likely effects of exchange rate depreciation on future inflation, especially during the agitated and highly fragile period of transition.

The results of this paper imply that the periods of transition, despite the volatile environment they bring, might lead to a more ordered and rule-based monetary policy setting. Facing the instability of the economy and traditional transmission channels and potential distrust in the institution itself, central banks might be driven to turn toward explicit policy targets and decision-making rules to build transparency and accountability, which are crucial requirements to produce desirable long-term outcomes of monetary policy. The enhancement of the independence of the central bank introduced during the transition period, as in the case of Tunisia,¹⁰ might further support this process.

Moreover, Tunisia and Egypt have been moving progressively to a more flexible exchange rate system during the period of transition to preserve their foreign currency reserves and enhance their exports. These countries have allowed their exchange rates to considerably depreciate against the main trading partners. As shown in [Figure 1](#), the current balance account in these countries was under constant pressure in the aftermath of the 2011 political events that hit the entire region. This move from a system based on an exchange rate anchor would possibly make inflation more volatile and might also be an incentive for central banks to follow a monetary policy based on inflation targeting, as highly recommended by Taylor (2000). Thus, even though the evidence on the shift toward a more rule-based policy is still weak, we might possibly expect further developments in that direction in the near future.

Further, the study demonstrates certain opportunism on the part of the central banks of Tunisia and Egypt when they conduct their monetary policies. The banks intensify their interventions to stabilize the current and future prices when the recent inflation exceeds an intermediate target, namely the previous year's quarterly average of the inflation rate. This result further confirms the heightened interest of these central banks in stabilizing inflation, either directly or indirectly, through an enhanced reaction to exchange rate fluctuations, taking advantage of favorable price surprises and being attentive to possible variations in future prices. In addition, this opportunistic behavior certainly contributes to controlling inflation in these two MENA countries and might also significantly contribute to shifting their monetary strategies to more rule-based policies in the future.

Disclosure statement

No potential conflict of interest was reported by the author(s).

¹⁰The Central Bank of Tunisia's independence was enhanced during the period of transition by its formal introduction in the new country's Constitution approved in 2014 and the new central bank law of April 2016.

ORCID

Brahim Guizani  <http://orcid.org/0000-0002-7388-2863>

Agata Wierzbowska  <http://orcid.org/0000-0001-8641-3217>

References

- Baaziz, Y., & Labidi, M. (2016). Nonlinear monetary policy rules: An essay in the comparative study on Egyptian and Tunisian central banks. *Economies*, 4(2), 6. <https://doi.org/10.3390/economies4020006>
- Ball, L. (2000, September). *Policy rules and external shocks*. (NBER Working Paper, No. 7910). National Bureau of Economic Research.
- Bank Al-Maghrib. (2005). Annual Report.
- Bank Al-Maghrib. (2006). Annual Report.
- Barro, R. J., & Gordon, D. B. (1983). Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics*, 12(1), 101–122. [https://doi.org/10.1016/0304-3932\(83\)90051-X](https://doi.org/10.1016/0304-3932(83)90051-X)
- Blanchard, O., & Fischer, S. (1989). *Lectures in macroeconomics*. MIT Press.
- Bomfim, A. N., & Rudebusch, G. D. (2000). Opportunistic and deliberate disinflation under imperfect credibility. *Journal of Money, Credit and Banking*, 32(4), 707–721. <https://doi.org/10.2307/2601179>
- Bunzel, H., & Enders, W. (2010). The Taylor rule and “opportunistic” monetary policy. *Journal of Money, Credit and Banking*, 42(5), 931–949. <https://doi.org/10.1111/j.1538-4616.2010.00313.x>
- Carvalho, C., Nechio, F., & Tristao, T. (2019). *Taylor rule estimation by OLS*. (Working Paper 2018-11). Federal Reserve Bank of San Francisco.
- Chailloux, A., Durré, A., & Laurens, B. (2009, July). *Requirements for using interest rates as an operating target for monetary policy: The case of Tunisia*. (IMF Working Paper, WP/09/149).
- Clarida, R., Gali, J., & Gertler, M. (1998). Monetary policy rules in practice: Some international evidence. *European Economic Review*, 42(6), 1033–1067. [https://doi.org/10.1016/S0014-2921\(98\)00016-6](https://doi.org/10.1016/S0014-2921(98)00016-6)
- Clarida, R., Gali, J., & Gertler, M. (2000). Monetary policy rules and macroeconomic stability: Evidence and some theory. *Quarterly Journal of Economics*, 115(1), 147–180. <https://doi.org/10.1162/003355300554692>
- De Gregorio, J. (2013). *How Latin America weathered the global financial crisis*. Columbia University Press.
- Friedman, M. (1960). *A program for monetary stability*. Fordham University Press.
- Ganev, G., Molnar, K., Rybiński, K., & Woźniak, P. (2002). *Transmission mechanism of monetary policy in Central and Eastern Europe*. (CASE Reports, No. 52).
- Gerlach, S., & Schnabel, G. (2000). The Taylor rule and interest rates in the EMU area. *Economics Letters*, 67(2), 165–171. [https://doi.org/10.1016/S0165-1765\(99\)00263-3](https://doi.org/10.1016/S0165-1765(99)00263-3)
- Gerlach-Kristen, P. (2003). *Interest rate reaction functions and the Taylor rule in the Euro area*. (Working Paper 258). European Central Bank.
- Helmi, M. H. (2011). Modeling monetary policy rules in the MENA countries: Issues and evidence. *International Journal of Social Sciences and Humanity Studies*, 3(2), 309–318.
- Hofmann, B., & Bogdanova, B. (2012). Taylor Rules and Monetary Policy: A Global ‘Great Deviation’?. *BIS Quarterly Review*, September, 37–49.
- Kydland, F., & Prescott, E. C. (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy*, 85(3), 473–492. <https://doi.org/10.1086/260580>
- Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root?. *Journal of econometrics*, 54(1–3), 159–178. [https://doi.org/10.1016/0304-4076\(92\)90104-Y](https://doi.org/10.1016/0304-4076(92)90104-Y)
- Laidler, D. (1993). Price stability and the monetary order. In K. Shigehara (Ed.), *Price stabilization in the 1990s* (pp. 331–356). The MacMillan Press.
- McCallum, B. T. (1987). The case for rules in the conduct of monetary policy: A concrete example. *Federal Reserve Bank of Richmond Economic Review*, 73, 10–18.
- McCallum, B. T. (1988). Robustness properties of a rule for monetary policy. *Carnegie-Rochester Conference Series on Public Policy*, 29, 173–203. [https://doi.org/10.1016/0167-2231\(88\)90011-5](https://doi.org/10.1016/0167-2231(88)90011-5)

- Mishkin, F. (1999). International experiences with different monetary policy regimes. *Journal of Monetary Economics*, 43(3), 579–605. [https://doi.org/10.1016/S0304-3932\(99\)00006-9](https://doi.org/10.1016/S0304-3932(99)00006-9)
- Moursi, T. A., Mosallamy, M. E., & Zakareya, E. (2007). *Effect of some recent changes in Egyptian monetary policy: Measurement and evaluation* (ECES working paper, No. 122). Egyptian Center for Economic Studies.
- Nelson, E. (2000). *UK monetary policy 1972–97: A guide using Taylor rules* (Working Papers, 120). Bank of England.
- Newey, W. K., & West, K. D. (1994). Automatic lag selection in covariance matrix estimation. *The Review of Economic Studies*, 61(4), 631–653. <https://doi.org/10.2307/2297912>
- Nikolsko-Rzhevskyy, A., Papell, D. H., & Prodan, R. (2014). Deviations from rules-based policy and their effects. *Journal of Economic Dynamics and Control*, 49, 4–17. <https://doi.org/10.1016/j.jedc.2014.09.034>
- Orphanides, A. (2001). Monetary policy rules based on real-time data. *American Economic Review*, 91(4), 964–985. <https://doi.org/10.1257/aer.91.4.964>
- Peersman, G., & Smets, F. (1999). The Taylor rule: A useful monetary policy benchmark for the Euro area? *International Finance*, 2(1), 85–116. <https://doi.org/10.1111/1468-2362.00020>
- Rotemberg, J. J., & Woodford, M. (1998). *An optimization-based econometric framework for the evaluation of monetary policy: Expanded version* (NBER Technical Working Paper Series, No. 223). National Bureau of Economic Research.
- Rudebusch, G. D. (1996). Is opportunistic monetary policy credible? Federal Reserve Bank of San Francisco. *FRBSF Economic Letter*, 96–28.
- Rudebusch, G. D. (2002). Term structure evidence on interest rate smoothing and monetary policy inertia. *Journal of Monetary Economics*, 49(6), 1161–1187. [https://doi.org/10.1016/S0304-3932\(02\)00149-6](https://doi.org/10.1016/S0304-3932(02)00149-6)
- Selim, H. (2012, March). *Exploring the role of the exchange rate in monetary policy in Egypt*. A paper presented in the ERF 18th Annual Conference.
- Sghaier, I. M. (2013). Taylor rule and monetary policy in Tunisia. *Journal of Finance & Economics*, 1(4), 30–41. <https://doi.org/10.12735/jfe.v1i4p30>
- Svensson, L. E. (2000). Open-economy inflation targeting. *Journal of International Economics*, 50(1), 155–183. [https://doi.org/10.1016/S0022-1996\(98\)00078-6](https://doi.org/10.1016/S0022-1996(98)00078-6)
- Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, 39, 195–214. [https://doi.org/10.1016/0167-2231\(93\)90009-L](https://doi.org/10.1016/0167-2231(93)90009-L)
- Taylor, J. B. (1999a). A historical analysis of monetary policy rules. NBER chapters. In J. B. Taylor (Ed.), *Monetary policy rules* (pp. 319–348). National Bureau of Economic Research, Inc., University of Chicago Press.
- Taylor, J. B. (1999b). The robustness and efficiency of monetary policy rules as guidelines for interest rate setting by the European Central Bank. *Journal of Monetary Economics*, 43(3), 655–679. [https://doi.org/10.1016/S0304-3932\(99\)00008-2](https://doi.org/10.1016/S0304-3932(99)00008-2)
- Taylor, J. B. (2000, November 14–15). *Using monetary policy rules in emerging market economies*. The 75th Anniversary Conference, “Stabilization and Monetary Policy: The International Experience”, Bank of Mexico.
- Taylor, J. B. (2012). Monetary policy rules work and discretion doesn’t: A tale of two eras. *Journal of Money, Credit and Banking*, 44(6), 1017–1032. <https://doi.org/10.1111/j.1538-4616.2012.00521.x>
- Taylor, J. B. (2017, May 18–19). *Central Bank Models: Lessons from the past and ideas for the future*. Annual Research Conference “The Role of the Central Bank in Economic Development” by the National Bank of Ukraine jointly with Narodowy Bank Polski.
- Walsh, C. E. (2017). *Monetary theory and policy*. MIT Press.

Appendices

1. Wald tests for structural breaks

We identify the break dates for the pre- and post-Arab Spring periods using the Wald test for a structural break at an unknown break date. The procedure is as follows. First, we estimate the test which, after trimming the sample at both ends, returns Wald statistics for all points in the sample. The test

estimates the break date at the point when the Wald statistic is highest. We either adopt that date as the break date in our model or analyze the developments of the Wald statistic and choose the date when Wald statistic is especially high, and which corresponds to the possible influence of the Arab Spring developments. In the latter case, we also estimate the Chow test for a structural break at the known break date to confirm that the chosen point really constitutes the structural break in the data. Figure A1 presents the estimated Wald statistics for each country and Table A1 holds the Chow test results.

The estimated break date for Tunisia (the highest value of the Wald statistic) is at 2008m11 (statistic value: 23.5645; p -value: 0.0065). Since the break date is before the Arab Spring and thus does not allow for estimation checking the impact of the popular uprising on monetary policymaking, we opt for the break date at 2011m7 when the estimated Wald statistic shows the second-highest and just slightly lower value, and which clearly constitutes for the second peak in the Wald statistic. The Chow test for a structural break on the known date supports this choice too.

The estimated break date for Egypt (the highest value of the Wald statistic) is at 2016m4 (statistic value: 21.1572, p -value: 0.0165). Since the break date is too far on the right and thus does not allow for estimation of the post-break date sample, we opt for the break date at 2011m11, when the estimated Wald statistic shows the second-highest value. The Chow test for a structural break on the known date supports this choice too.

The estimated break date for Morocco (the highest value of the Wald statistic) is at 2012m3 (statistic value: 49.8479; p -value: 0.0000), which we adopt as our break date in the estimations of Taylor rule.

Table A1. Chow tests based on the open-economy Taylor rule.

Country	Egypt	Morocco	Tunisia
Break date	2011m11	2012m3	2011m7
Test statistic	13.844**	49.848***	23.242***

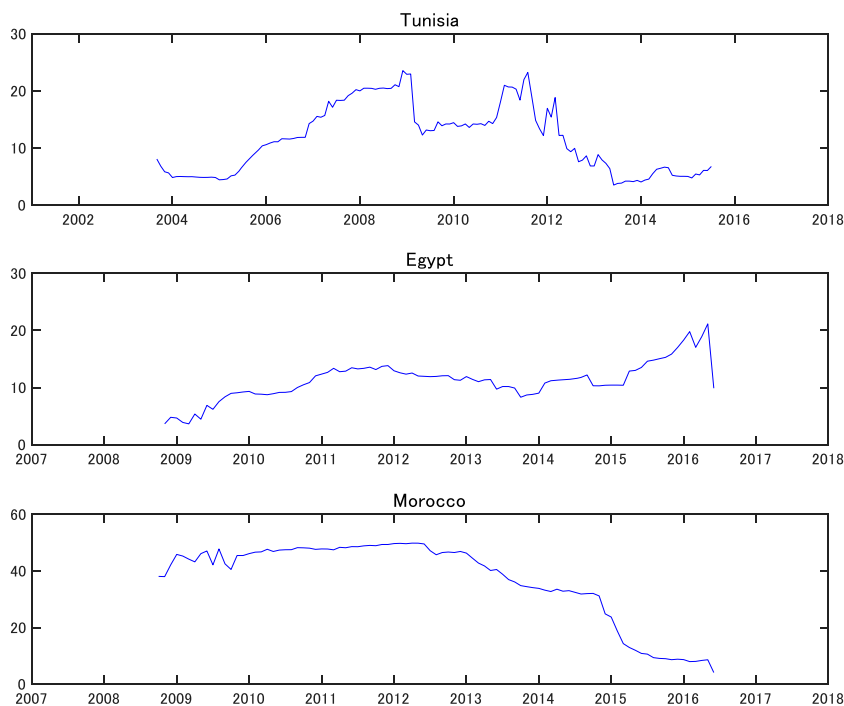


Figure A1. Estimated Wald statistics for Tunisia, Egypt, and Morocco. Source: own estimations.

2. Unit root tests

Table A2. Unit root test results.

	Full sample								
	Egypt			Morocco			Tunisia		
	ADF	PP	KPSS	ADF	PP	KPSS	ADF	PP	KPSS
Output gap	-3.94*** (1)	-4.94*** (1)	0.114 (7)	-3.007** (5)	-3.083** (5)	0.123* (7)	-3.437*** (10)	-9.869*** (10)	0.0531 (10)
Inflation gap	-2.46 (3)	-1.64 (3)	0.262*** (7)	-4.009*** (10)	-3.702*** (10)	0.0959 (7)	-3.175** (2)	-2.621* (2)	0.0701 (10)
Exchange rate change	-7.89*** (1)	-8.95*** (1)	0.062 (2)	-9.562*** (1)	-16.57*** (1)	0.046 (4)	-8.672*** (1)	-11.42*** (1)	0.0965 (7)
Interest rate	-0.11 (10)	1.08 (10)	0.255*** (7)	-0.204 (5)	-1.027 (5)	0.354*** (7)	-2.247 (3)	-1.893 (3)	0.23*** (10)
	Pre-sample								
	Egypt			Morocco			Tunisia		
	ADF	PP	KPSS	ADF	PP	KPSS	ADF	PP	KPSS
	Output gap	-3.364** (1)	-3.736*** (1)	0.174** (5)	-1.844 (2)	-1.791 (2)	0.199** (5)	-3.103** (10)	-7.921*** (10)
Inflation gap	-3.359** (4)	-1.95 (4)	0.112 (5)	-2.327 (10)	-2.48 (10)	0.0856 (5)	-3.615** (3)	-2.717* (3)	0.055 (7)
Exchange rate change	-2.934** (7)	-5.604*** (7)	0.067 (5)	-7.572*** (1)	-13.28*** (1)	0.0706 (3)	-11.59*** (0)	-11.59*** (0)	0.139* (9)
Interest rate	-2.613* (4)	-1.64 (4)	0.127* (5)	-3.609*** (4)	-5.25*** (4)	0.071 (5)	-1.088 (3)	-0.862 (3)	0.104 (7)
	Post-sample								
	Egypt			Morocco			Tunisia		
	ADF	PP	KPSS	ADF	PP	KPSS	ADF	PP	KPSS
	Output gap	-2.155 (2)	-3.267** (2)	0.107 (5)	-1.885 (8)	-2.758* (8)	0.107 (5)	-4.55*** (1)	-5.42*** (1)
Inflation gap	-3.187** (9)	-1.106 (9)	0.193** (6)	-3.332** (6)	-2.963** (6)	0.0699 (5)	-1.851 (8)	-2.335 (8)	0.117 (6)
Exchange rate change	-5.947*** (1)	-6.72*** (1)	0.071 (0)	-5.09*** (1)	-6.38*** (1)	0.049 (4)	-4.89*** (1)	-6.31*** (1)	0.0775 (5)
Interest rate	-0.423 (10)	1.136 (10)	0.264*** (6)	-0.771 (2)	-1.274 (2)	0.114 (6)	-2.339 (4)	-1.131 (4)	0.199*** (6)

Notes: ADF: Augmented Dickey-Fuller test; PP: Phillips-Perron test; KPSS: Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) test. Tests against null hypothesis of unit root in case of ADF and PP, and null hypothesis of stationarity in case of KPSS. Numbers in brackets – lag order used for test, based on AIC for ADF and PP, and on max lag order automatic bandwidth selection procedure proposed by Newey and West (1994) for KPSS.