ECONOMIC RESEARCH FORUM

منتدى البحوث الاقتصادية

2011

working paper series

INFLATION FORECAST-BASED RULE FOR INFLATION TARGETING: CASE OF SOME SELECTED MENA COUNTRIES

Houda Ben Hadj Boubaker

Working Paper No. 628

INFLATION FORECAST-BASED RULE FOR INFLATION TARGETING: CASE OF SOME SELECTED MENA COUNTRIES

Houda Ben Hadj Boubaker

Working Paper 628

September 2011

Send correspondence to:
Houda Ben Hadj Boubaker
Institut Supérieur de Gestion de Tunis, Tunisia
houda.benhadjboubaker@isg.rnu.tn

First published in 2011 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

Inflation targeting is an attractive monetary policy strategy because it could reduce inflation and improve central banks' credibility, which is what motivated its adoption previously by industrial countries and recently by emerging ones. This paper considers to what extent some selected MENA countries can adopt inflation targeting. To this end we estimate a monetary policy derived from the flexible inflation forecast targeting based-rule. The aim of this paper is to estimate a reaction function that fits the inflation-targeting framework in accordance with the specificity of the transmission mechanism into these countries.

ملخص

يعتبر استهداف التضخم استراتيجية جذابة للسياسة النقدية لأنها يمكن أن تقلل من معدلات التضخم وتساعد على تحسين مصداقية البنوك المركزية، وكان ذلك من دوافع اعتماد هذه الاستراتيجية من قبل الدول الصناعية والاقتصادات الناشئة في الآونة الأخيرة. تبحث هذه الورقة إلى أي مدى تستطيع ان تتبنى بعض البلدان المختارة من منطقة الشرق الأوسط استراتيجية استهداف التضخم. وتحقيقا لهذه الغاية فإننا نقدر سياسة نقدية مرنة مستمدة من توقعات التضخم. الهدف من هذه الورقة هو تقدير دالة رد الفعل التي تناسب إطار استهداف التضخم وفقا لخصوصية آلية الانتقال إلى هذه البلدان.

1. Introduction

Many countries, especially the industrialized ones adopted the inflation targeting, for example New Zealand, Canada, the United Kingdom, Sweden, Finland, Spain among many others. Inflation targeting is characterized by the announcement of a numerical target for inflation over a specified horizon, which can be expressed as a range (the majority of inflation targeted countries) or a point. The ultimate objective of this monetary policy strategy is to maintain price stability.

There was a debate over whether inflation targeting should be considered as a framework or a monetary policy rule. Bernanke and Mishkin (1997) and Bernanke et al. (1999) state that inflation targeting cannot be reduced to a mechanical rule since in practice it requires monetary authorities to consider all possible relevant information and use structural models and judgment in achieving its objectives. Interpreted as a rule, inflation targeting entails a loss of flexibility due to the fact that focusing essentially on inflation may induce a sacrifice of other real indicators (output and employment). Inflation targeting in the sense of Svensson (1999) can be interpreted as a rule rather than a framework. The central bank is committed to achieve price stability through minimizing a quadratic loss function that responds to deviations of inflation and output from their targeted levels. From this perspective, the policy decision is expressed through a targeting rule, especially a *flexible* inflation-targeting rule with the conditional inflation forecast as an intermediate target variable.

The success of inflation targeting in industrial economies, gave an appetite to emerging ones to follow this regime. Many reasons stand behind this interest. The comparison of the average rate of inflation and its volatility before and after the adoption of inflation targeting by some industrialized countries confirm the success of the regime in reaching its expected outcomes in terms of inflation reduction in the short and long-term (King (1997))[1]. Moreover, money growth and exchange rate targeting as alternative monetary policies were found to be inefficient for achieving price stability[2]. Tunisia, Morocco and Egypt retain the price stability as the overriding objective of their monetary policy strategy. With the widespread use of inflation targeting and the advantages that can be drawn from it, it is interesting to check for the feasibility of such a regime in these three selected MENA countries[3].

The issue of inflation targeting implementation in emerging markets has received a considerable attention from economic organizations, central banks and academics. Indeed, concerned with the international stability the International Monetary Fund (IMF) brought its interest on promoting inflation targeting in emerging markets, (Masson et al (1997), Schaechter et al. (2000)). Recently[4] the OECD organized jointly with the Bank of England a seminar on monetary policy in emerging markets (De Mello (2008)). The important role in this field remains the one played by central banks (emerging and non-emerging ones).

The existing literature was merely concerned with the assessment of prerequisites with little research focusing on the implementation of inflation targeting framework in MENA countries. There is a need then, to further develop the other aspects of this framework, which is the purpose of this paper. Our contribution is to estimate a rule that is compliant with inflation targeting for selected MENA countries. This paper makes explicit a macroeconomic

[1] Many studies assess the inflation targeting history, achievement and the state of art; see the speech (1999, 2003) for the Reserve Bank of Australia, king (2005) for the Bank of England among many others.

[2] Svensson (1997 a, 1999 b). Many experiences witness the failure of the monetary growth or the exchange rate targeting, for example the Central East European Countries abandon the exchange rate targeting in 1998 in favor of direct IT, Hungry leaves the crawling peg in 2001, the US abandons monetary targeting in1993.

[3] It is worth noting that the Economic Research Forum (ERF) workshop of 24-25 October 2008 constitutes a reference for the inflation targeting in MENA countries.

[4] On 28 February 2007.

model, which stems from the structure of the economy and the transmission mechanisms, a central bank loss function and a monetary policy rule.

The remainder of this paper is a follows. Section 3 analyses the inflation-targeting framework, as well as the necessary condition for its implementation and the readiness of the considered countries to adopt it. Section 4 estimates a new Keynesian structural model, which consists of an aggregate demand, aggregate supply and exchange rate equations. The reliability of the obtained results is assessed through a simulation experiment. In the final section, we evaluate whether the transition to inflation targeting is an appropriate option and draw policy implications.

2. Inflation Targeting Framework

2.1 Inflation targeting strategy

Although the divergence of standpoints about how inflation targeting is considered, the advantages of this strategy are commonly approved. Under inflation targeting, the central bank reinforces transparency by announcing how it will conduct its monetary policy. Indeed, the choice of the target level and the horizon to be reached as well as the objectives setting and the plan established to fulfill them by the authorities are communicated to the general public (Mishkin 2002 p.361). For instance, inflation-targeting banks publish regular inflation reports, such as the bank of England and the Reserve Bank of New Zealand[5]. Also transparency has a bearing on the private sector, which relies on the central bank's projections; the inflation reports published provide the long-run implications of the current policy action are then, of great importance to the private sector to adjust planning[6]. Many studies point out the gain produced by transparency of inflation targeting reports of central banks, see the recent survey papers by Svensson (2009), Walsh (2007), and precedent ones by Svensson (1999) and Mishkin and Posen (1997, Part II).

Furthermore, the higher degree of transparency associated with inflation targeting regime held the central bank accountable for attaining its goals and hitting the inflation target. In fact, more the central bank's accomplishment is close to the announced objectives, more it is credible and more its reputation is preserved. Consequently, the central bank can handle the time-consistency problem.

2.2 Inflation targeting prerequisites

To be operational, inflation targeting requires some technical requirements to be fulfilled for its success. The prerequisites are necessary on three levels. First, the institutional level deals with the independence and autonomy of the CB. Debelle and Fischer (1994) distinguishes between goal and instrument independence. The latter implies a complete freedom of the CB in the choice of the instrument that it considers as the best to accomplish the policy's goals. This *operational* independence suggests then a goal independent or dependent CB. To be considered as goal independent a CB must decide which goal it will pursue without any interference of the government. But, CB and the government should communicate publicly

[5] In February 1993 the bank of England was the first inflation-targeting bank that published its inflation report and in November 1997 started to plot its output forecasts. Also, it publishes the minutes of the MPC meetings. Following the same steps, in December 1997, the Sveriges Riksbank released its inflation report and plotted the conditional forecast of inflation for a constant unchanged interest rate. The Reserve Bank of New Zealand plots conditional forecasts for inflation, the output gap, the three-month interest rate and the exchange rate.

[6] Cecchetti and Hakkio (2009) investigate the effect of transparency stemming from inflation targeting on private agents reaction. Their survey was motivated by the results of Morris and Shin (2002 and 2005), which show that the public information involves an overreaction of private agents to central bank signals. Their estimation did not sustain that transparency leads to lower dispersion in private forecasts but they state that: "However, even if the inflation target is for the medium-run, one would expect that the dispersion of inflation forecasts for 'next year' may still be somewhat smaller than otherwise."

the reasons behind their adoption of the monetary policy strategy and announce the target. Thus, besides the charge of lower inflation, the independence of the CB reinforces its accountability and transparency vis-à-vis of the public. The fiscal actions undertaken by the government should not interfere with monetary policy objectives, if the case arises, the monetary policy would suffer from non-effectiveness due to the inflationary pressures of a fiscal origin. So the absence of fiscal is necessary for CB independence.

The economic level comprises empirical issues such as the price index that will be used as an inflation target, the knowledge of transmission mechanism and the exchange rate regime. Inflation forecasting capabilities are crucial since they require the presence of macroeconomic databases, a well-defined forecasting model, a technical equipment to execute it and then the time of forecasts release.

Given the interactions between the CB policies and the financial markets a healthy financial system seems to be another essential ingredient. The banking system underpins the financial one; hence the unsoundness of the former leaves the CB inefficient to handle the inflation target and sparks off the instability of the later. The development and stabilization of the financial system enhance the efficiency of monetary policy, bolster the transmission channel of the effects of monetary policy to production activity and prices and avoids the financial crisis.[7]

2.3 Assessment of prerequisites

A lot of interest was and still is given to the economic and institutional preconditions of the inflation-targeting framework in emerging markets. Mishkin (2004) argues that the independence precondition fulfilment requires a support of the public and political institutions; also the fiscal policy and financial systems need reforms. De Mello (2008) (OECD publishing) focuses on the experience of six emerging countries with inflation targeting and concludes about the preconditions that a low fiscal dominance and a more developed financial system are necessary.

The FEMISE (2008) workshop focused on the adoption of the inflation-targeting framework in MENA countries. Boughrara et al. (2008) was concerned by the case of Tunisia and Morocco; their evaluation suggests weak independent central banks. Indeed the government takes hold of goals and the missions of the CB definition. Hence the accountability is also weak since the CB is only accountable to the government as well as the transparency, with no explanation of the goals achievement is giving to the public. The reforms made in the Tunisian banking system endeavor for more flexibility and stability, something that did not happen due in large part to, non-performing loans (NPL) and the lack of BCT independency. Likewise, despite the reforms undertaken from the beginning of the nineties, the Moroccan financial system continues to face significant challenges related to improving the competitiveness of banking institutions, development of insurance markets and capital, modernization of payment systems, and further strengthening of the supervisory framework. The government relies already on the financial system for its debt financing and despite the lower fiscal deficit its fiscal dominance still hinders the CB to manage the interest rate[8].

In Egypt the evaluation seems to be more optimistic. Al-Mashat (2008) argues that Egypt made considerable progress toward IT adoption. The central bank of Egypt (CBE) is an instrument independent by the law, whose credibility was insured through the rating score, its transparency enforced by the communication of the monetary policy committee meeting and by a plan which aims to inform the public (MPC publishing and press and academic conferences). The budget deficit weighs heavily on the Egyptian economy , which requires a

[7] Batini & Laxton (2006) consider four prerequisites and constitutes a set of indicators for each one.
[8] See Boughrara (2007) for more details.

firm compliance to the fixed fiscal consolidation program fixed by the government and the IMF (2006). Egypt endows its forecasting system with the necessary procedures (the sophisticated techniques are underway). The banking system reforms allow for banks privatization and NPLs settlement.

3. Inflation targeting implementation

Despite the advantages of inflation targeting framework, its implementation and monitoring are still difficult. Svensson (1997a) ascribe that the imperfect control over inflation owes to the effects of monetary policy factors (variables lags) and instruments changes on inflation during the control lag. Subsequently, monetary policy evaluation is hard to be set; especially that inflation is determined after the forecast horizon. Thus, the imperfect control of current inflation is an obstacle to inflation targeting, for reasons of transparency and credibility. To counter this problem, central banks should adopt a forward-looking procedure by targeting the inflation forecast, which is considered, henceforth, as an intermediate target[9]. The reason is that the forecast is correlated with the target (goal), easy to be controlled -reinforcing thus the transparency- and more predictable than the target. The conditional inflation forecast allows also taking into account the new information and hence, the instrument adjustment depends on the effect of this new information on the intermediate target. Moreover, under such a consideration the first-condition characterizing the optimal equilibrium is achieved.

To implement inflation targeting central banks needs to define a procedure that assures price stability and stands for a commitment. The first step, which refers to the "high-level" policy specification (in Svensson terminology), is to assign a loss function that will be minimizing. The second step is the intermediate-level or "specific-level" which expresses the policy decision through the construction of inflation forecasts conditional to the current set of information and the instrument monetary policy paths. Hence the second step amounts to an "inflation-forecast targeting" rule where the target must fulfil the first-condition to minimize a (given) loss function, see Svensson (1997a, 1999) and Svensson and Woodford (2005).

It is true that the loss function reflects the central bank preferences, but these preferences stem from the structure of the economy, which is expressed into a model. Indeed, the model provides a clear description of the relationship between the key variables, which are inflation, and the output gap (other exogenous variables can be added such as the exchange rate). The goal of the macroeconomic model is to determine the instrument (interest rate) path necessary to achieve inflation target by including the channels through which it affects inflation. It follows that specifying the macroeconomic model comes before all when central banks attempt to implement inflation targeting.

3.1 The model

We endeavored, when formulating the model, to use the theoretical and empirical elaborated macroeconomic models to support the implementation of inflation targeting in the real economic context of Tunisia, Morocco and Egypt. To this end, we use a small open economy forward-looking model. The new Keynesian framework[10] gradually swept the field of inflation targeting. It focuses on the relationship between inflation and real variables, which

[9] King (1994) emphasizes that having an inflation target imply intermediate inflation target.

[10] The essence of New Keynesian theory reviewed in Gordon (1990) was centered around the stickiness of the aggregate price level, Calvo (1983) by proposing a Phillips curve where inflation depends on expected values resolve a problem faced by the determination of the degree of price stickiness that is "inertia effects". Some authors, (e.g. Fuhrer and Moore (1995) and Estrella and Fuhrer (2002)) found such specification does not replicate the "hump-shaped" behavior of inflation in response to shocks. These contradictions lead to a more elaborate Phillips curve known as Hybrid New Keynesian Phillips Curve (HNKPC) proposed by Gali and Gertler (1999) which allows for well inflation dynamics as occurs when is tested against a backward-looking behavior of price setting.

is of great importance for monetary policy analysis given the imperfect control of inflation. Building a macroeconomic model that takes into account the forward-looking behavior of private agents and central banks, besides incorporating the exchange rate, seems necessary in an open economy inflation targeting discussion.

The forward-looking model is characterized by a forward-looking Phillips curve and aggregate demand, it is similar to the general-equilibrium model employed by Rotemberg and Woodford (1998)[11], which is optimized under rational expectation, and it is found to fit to the time series features. We consider a small open economy model as proposed by Doménech et al. (2001) for the analysis of transmission mechanism for the EMU for the period of 1986 to 2000. However, our study differs in many aspects. First, Svensson (2000) criticizes Ball (1999) for relying on a backward equation for exchange rate, which violates the exchange parity and non-arbitrage, so for raison of insight the forward-looking exchange rate term is introduced. Second, the rule estimated in Doménech et al. (2001) is an inflation-targeting rule; in our case we consider an Inflation forecast-based rule, as it will be discussed in section (.).

$$\pi_t = \alpha_1 \pi_{t+1/t} + (1-\alpha_1)\pi_{t-1} + \alpha_2 y_t + \alpha_3 e_{t+1/t} + \varepsilon_t \qquad \alpha_i > 0 \qquad (1)$$

$$y_t = \beta_1 y_{t+1/t} + (1-\beta_1) y_{t-1} - \beta_2 (i_t - \pi_{t+1/t}) + \beta_3 e_{t+1/t} + \theta_t \quad \beta_1 \, and \beta_2 > 0 \quad \beta_3 < 0 \quad (2)$$

$$e_t = \delta_1 e_{t+1/t} + \delta_2 (r_t - r_t^*) + \vartheta_t \qquad \delta_i > 0 \qquad (3)$$

Equation (1) is a hybrid Phillips curve-type proposed by Gali, Gertler and Lopez-Salido (2001). The inflation rate depends on its expected and lagged values, the lagged output, the change in expected exchange rate and a shock. The effect of exchange rate is set positive since it is conducted directly through the imports prices. Equation (2) is the aggregate demand curve, where the output gap depends on its own lags and its expected values besides the real one-period interest rate and the expected values of nominal exchange rate. Equation (3) of the exchange rate is derived from the interest rate parity condition, where e_t is the NEER, r_t defined above, r_t^* stands for the foreign real interest rate. ε_t, θ_t and ϑ_t is a white noise exchange rate shocks of inflation, output gap and exchange rate, respectively. The forward behavior is expressed through $x_{t+1/t} = E_t x_{t+1}$ which is the expectation of x_{t+1} in time t+1 conditional to information available at time t.

3.2 The loss function

Should inflation targeting be strict or flexible? The strict inflation targeting is the case when the only concern of the central bank is to bring inflation closer to a target as quick as possible, without considering the impact on the interest rate, exchange rate, and output and employment, thus causing some instability. The flexible inflation targeting implies a gradualist policy to capture the uncertainty about the parameters of the economy and the nature of the shock that the economy is exposed to. Under the flexible regime, the central bank aims at stabilizing both inflation and real variables and adjusts inflation to the target over a longer horizon (see Svensson (1997a)[12]). Therefore, in our paper we consider a flexible inflation-targeting regime.

[11] Moreno (2004) employs the same model in order to understand the factors behind the low inflation volatility in the US. In the same vein, De Mello and Moccero (2008) test the effect of changes in monetary regime on macroeconomic volatility for some emerging market economies (Brazil, Chile, Colombia and Mexico).

[12] Among banks which pursuit flexible inflation targeting there are: Reserve Bank of New Zealand, Norges Bank, Sveriges Riksbank, (→I have to consult the central bank sites to determine the countries adopting flexible IT).

Which loss function to use? The central bank guides the policy choice through an objective or a "loss function" which defines the stabilization objectives. Indeed, the loss function penalizes the target variables by assigning weights to their deviation from the target levels. These weights refer to the central bank preferences. The conventional quadratic form of the period loss function is given by

$$L_t = \lambda_\pi(\pi_{t+\tau} - \pi^*)^2 + \lambda_y y_{t+\tau}^2 \qquad (d)$$

The expected sum of the period loss functions express the central bank problem as the intertemporal loss function in quarter t as

$$E_t \sum_{\tau=0}^{\infty} \beta^\tau L_t$$

Where π_t is the inflation in period t, $\pi^*$is the inflation target, y_t is the output gap, $\lambda_i \geq 0, for\ i = \pi,\ ,y$, are the relative weights on stabilizing the inflation and the output gap and exchange rate smoothing, respectively. The strict (flexible) inflation targeting corresponds to $\lambda_y = 0\ \ (\lambda_y \neq 0\ )$ and β is the discount factor.

The loss function expression may include other variables besides the inflation and output gaps. Rudebusch and Svensson (1999) use a loss function with interest rate smoothing, where the interest rate difference is considered as an additional goal variable. Svensson (2003) discusses the case when the interest rate and the exchange rate stabilization and smoothing are parts of the loss function. He indicates that exchange rate smoothing is implicitly induced by the degree of the exchange rate pass-through. The loss function[13] is as follows

$$Min_i\ L = E_t \sum_{\tau=0}^{\infty} \beta^\tau \left[\lambda_\pi(\pi_{t+\tau} - \pi^*)^2 + \lambda_y y_{t+\tau}^2 + \lambda_i(i_{t+\tau} - i_{t+\tau-1})^2 + \lambda_e(e_{t+\tau} - e_{t+\tau-1})^2\right] \qquad (4)$$

3. Monetary policy rule for inflation targeting

3.1 Monetary policy rules typology

Policy rules as a guideline in the conduct of monetary policy has gained a particular interest since the nineties with the influential article of Taylor in 1993. A growing literature explores a variety of rules derived from the Taylor rule and attempts to adapt them to policy-makers objectives and economic behavior. Table 1 in Appendix A summarizes the Taylor rule and its derivations. So, analytical and empirical studies are an upward requirement for a better understanding and distinction among the different developed rules, especially with the adoption of inflation targeting framework by many countries, for example, Kuttner (2004) gives a useful distinction between the different sorts of policy rules.

Questions have been raised about how to describe inflation targeting. Essentially, the literature asked whether inflation targeting is an instrument rule or targeting rule. *Instrument rule* is a simple rule, which involves a small set of information to describe the reaction function. The instrument is expressed in term of predetermined variables or forward-looking variables or both. This is the case of Taylor's rule that has the advantages of being easy to implement and well understood by outsiders and hence, allows the central bank to (mechanically) track the rule. While, the *targeting rule* describes a relation between the target variables and their target levels so the loss function is minimized. The central bank defines

---

[13] Giannoni and Woodford (2003) optimize the same loss function for a forward-looking macroeconomic model. They propose also, many types of loss functions, which combines different target variables such as inflation, output gap, wage inflation, current and lagged output gap. All the loss functions are considered with and without interest rate stabilization.

the instrument rule path corresponding to target variables paths that minimize the loss function. Such rules were explored by many studies in the context of inflation targeting design. In fact, central banks prefer setting their policy instrument based on all relevant information provided by the available and the forecasted target variables, than pursuing a statement as a relationship between the control variable and the observable state. Although, despite the easy implementation of instrument rule, some works found that inflation targeting would be best qualified as a targeting rule which was more advantageous to achieve the inflation target, Svensson (1997a-b, 1999, 2002, 2003, and 2005) Svensson and Rudebusch (1998)[14] and Svensson and Woodford (2005).

3.2 Inflation forecast based rule as the centrepiece in inflation targeting

The Inflation Forecast Based rule, (henceforth IFBR) introduced by Batini and Haldane (1999), is considered as a simple ad hoc rule as is the Taylor rule. This is not to say that they are similar, however. The inflation gap is no longer based on the previous values of inflation rate but on the expected values of future inflation. Hence the IFBR rule embodies a forward looking dimension in that is it takes into account the lag between monetary policy stance and its effects on the economy. IT is noteworthy to distinguish IFBR from Inflation forecast targeting (IFT) rule developed in Svensson (1997 a) and Rudebusch and Svensson (1999). IFT rules determine the optimal path of instrument variable by minimizing a loss function through a quadratic linear economic control problem.

The IFBR is written as follows

$$i_t = \gamma i_{t-1} + (1-\gamma){r^*}_t + \theta\left[E_t\pi_{t+j} - \pi^*\right]$$

Where E_t is the expectation parameter based on information available at time t, γ accounts for the interest rate smoothing. θ is the policy feedback parameter ($\theta > 0$), it expresses the aggressiveness of the policy response, that is when θ is large the central bank quickly adjusts the expected inflation to its target. j is the horizon of inflation forecast, when j = 0 only the actual set of information will feed back the central bank rule, but when ($j > 0$), the deviation of forecasts from the target is considered instead. γ is the smoothness parameter, the large value of γ indicates the preference of the central bank towards smoothing the interest rate.

Major empirical studies on IFBR, spawned in no small part by Batini and Haldane (1999), highlight benefits of such a rule. They argued for the superiority of IFBR comparing it to the Taylor rule, for many reasons. First, policymakers look for a pre-emptive monetary policy, the IFBR as a forward-looking rule takes into account the lagged action of monetary policy through the forecast horizon (it is referred to the lag-encompassing property). Hence, the IFBR allows for curbing future inflationary pressures. Second, the information embodied into the expected inflation makes the IFBR able to respond immediately to economic shocks according to whether it is expected to be persistent or transitory (information-encompassing property). Finally, given the short-term trade-off between inflation and output, the policy parameters (j, θ) can be chosen to ensure output stability, it is referred to as output encompassing. Clarida et al. (2000) find that the policy of US from 1960:1 and from 1996:4 was well described using a rule that feeds back from expected values of inflation and output and accounts of interest rate smoothing. Amano et al. (1999), throughout the simulation experiment, show that IFBR has beneficial properties, such that it ensures output stability, and is flexible to credibility increase. They join Batini and Haldane (1999) view that IFBR requires all relevant information as it is encompassed by the inflation forecast variable.

[14] Do not explicitly define reaction functions, and they restrict instrument rules to be prescribed (explicit) reaction functions, whereas the current treatment allows instrument rules to be both explicit and implicit reaction functions.

Moreover, IFBR allow policy-makers to control the lag, indeed when j (interest rate) increases the interest rate (*j*) is expected to increase. Controlling the monetary policy lag is important since high horizons may induce indeterminacy. The capability of IFBR towards indeterminacy was investigated empirically as well as analytically. Levin et al. (2001) found that to model uncertainty a robust IFBR must include a response to current output gap, a high degree of inertia and one-year inflation forecast. Batini and Pearlman (2002) showed analytically that the IFBR brings about instability and indeterminacy[15]. Recently, Levine, McAdam and Pearlman (2006) proposed a Calvo-type IFBR to remedy the indeterminacy implied by standard ones. Their findings suggest that a Calvo-type rule considered in a difference form with infinite forward horizon performs well.

The implementation of IFBR evidences its usefulness and precisely, its fitness to inflation targeting framework. The two pioneer inflation-targeting central banks, the Reserve Bank of New Zealand and Bank of Canada use IFB-type rules in monetary policy practice[16]. The inflation forecast based rule considered in our paper adjusts the short-term interest rate in response to the smoothed interest rate, the expected inflation and the output gap and is given by

$$i_t = \gamma i_{t-1} + (1-\gamma)\left(r^*{}_t + \theta_\pi\left[E_t\pi_{t+j} - \pi^*\right] + \theta_y y_t\right) \quad (5)$$

4. Empirical Investigation

4.1 Data description

We consider three countries in this study, which are Tunisia, Morocco and Egypt. The estimation, based on quarterly data, includes four explanatory variables, which are the most relevant to IT, framework. It is about, the exchange rate, the interest rate, real GDP and price indexes. All variables except the interest rate are taken in their algorithm form. The period ends to 2009:4 and it starts from 1988:1 for Tunisia and Egypt, and from 1990:1 for Morocco and Egypt. Table 1 provides the detailed data description as well as the source.

4.2 Methodology issues

Dealing with forward-looking rules raises two major problems. First, is the endogeneity problem that may be detected between variables and error term and leading to instrument them. Second, is the problem related to heteroscedasticity of the error term what held in miss-specified coefficients of the model under study. To encounter these problems the General Method of Moment (GMM) is employed. Clarida et al. (1998) introduced the use of the GMM method to estimate monetary policy reaction function . They estimated a forward-looking monetary policy reaction function for the G3 and the E3[17] countries. The authors considered alternatives of their baseline rule[18] by including other variables such as the lagged inflation, money supply, Fed's rate and the real exchange rate of domestic country over the dollar. The orthogonality condition required by the GMM estimator implies that the expected values of the variables of interest are replaced by their realized values. Moreover, the over-identification tests strength the forward-looking specification when the null hypothesis validates the instruments choice. The estimation results suggest that the strategy of central

---

[15] Batini and Pearlman (2002) analyse the stability and determinacy of different parameterizations of the IFBR. They employed the AS-AD model to construct the inflation-output frontier and the root-locus technique to define the (θ, j) which illustrates the behavior of these roots when θ changes. Their results contrasted those of Levin et al. (2001) about the long-term effects of persistency to avoid indeterminacy.

[16] Coletti et al. (1996) propose a Quarterly Projection Model for Bank of Canada, including IFBR given by equation 6 p.46, with a strict inflation targeting loss function. Black et al. (1997) for the Reserve Bank of New Zealand adopt the same rule in the Forecasting and Policy System.

[17] G3 are Germany, Japan and the US and E3 are UK, France and Italy.

[18] $r_t^* = \bar{r} + \beta(E[\pi_{t+n}/\Omega_t] - \pi^*) + \gamma(E[y_t/\Omega_t] - y_t^*)$, where r_t^* is the target nominal interest rate, $\bar{r}$ the long-run equilibrium nominal rate, Ω_t is the set of information at time t and E(.) is the expected operator.

banks under study during the period of 1979 was to be more efficient if they adopted inflation-targeting rule. Following the same procedure, Gerlach and Schnabel (2000) estimated a forward-looking rule type CGG (1998) as well as the Taylor rule for the European Monetary Union (EMU) from 1990 to 1998. They concluded that both of rules two are convenient to EMU monetary policy. Adam et al. (2005) investigate the monetary policy of UK over five periods covering the post-pre exchange rate Mechanism (ERM) and the Monetary Policy Committee (MPC) periods. The study tests the effects of external interest rate (US and Germany) on the reaction function. They show that while international variables determined the conduct of the monetary policy in UK during the post-ERM period, domestic inflation and output gap conditioned it during the MPC period. The authors attribute this result to the institutional changes in 1997 that allowed the central bank to be instrument independent rather than the adoption of inflation targeting in 1992.

Florens et al. (2001) estimates the reaction function of the Federal Reserve Bank using three alternatives of the GMM method: the two-step, the iterative and the continuous-updating GMM. They found that the two-step GMM provides the smallest standard errors of estimation and it produces same results as the maximum likelihood approach. The GMM approach has many advantages. It is less restrictive regarding the innovations distribution and it allows for the inference of the over-identification test (Hansen (1982)). This method is more appropriate than the OLS since it encounters the problem of endogeneity when we assume that innovations are uncorrelated with the instrumental variables. The reproach for using the GMM method is that the theory behind the choice of the set of instruments is not persuasive.

4.3 Estimation of the structural model

Table (2) resumes the estimation result of the GMM, instrumental variables considered in the estimation are given in table () for the equation (1), (2) and (3). The lag length is determined using the Newey-West fixed bandwidth Table GMM reports the parameters estimates. The J-statistic supports the over-identifying restrictions implied by the model. The hybrid inflation equation shows that inflation is highly explained by the lagged output gap for the three countries. α_2 values imply a long-run trade-off between inflation and output. Estimation of the aggregate demand equation depends on the expected values of output gap and weakly on the real interest rate. The expected exchange rate seems to be without effect on inflation and output. The exchange rate equation depends only on its expected values and the risk premium is only significant for Tunisia.

4.4 Estimation of monetary policy rules

Two sorts of rules are estimates: the Taylor rule and the IFBR in an attempt to suggest a rule that can fit the data of MENA countries under study.

The Taylor estimation are strongly different from the original Taylor specification, parameters have wrong sign almost the time. According to the results of table we reject the Taylor rule for the selected MENA countries.

The GMM estimation of the IFBR in Table 3 shows a more significant coefficient in the case of strict than in the case of flexible inflation targeting. The point estimate of the inflation parameter θ_π changed slightly. Furthermore, the output gap parameter is not significant; this result indicates that the central banks of Tunisia, Morocco and Egypt may focus the monetary strategy on fighting inflation more than stabilizing output.

Conclusion

Our study attempts to provide a framework for the implementation of inflation targeting for three of MENA countries considered as more ready to adopt this new strategy by the IMF (2006). Our findings seem to be in favor of the adoption of inflation targeting where the central bank determines the paths of its interest rate through an inflation forecast based rule. However, it will be a lot of work to do at an institutional level.

Many perspectives for our work suggest the use of forecasts of inflation and output in order to estimate the IFBR and to define a more effective monetary policy. Moreover, monetary policy rule must respond to the structural breaks of the economy, to this end in further research we suggest a time-varying IFBR.

References

Adam, C., Cobham, D. and Girardin, E. (2005)," Monetary Frameworks and Institutional Constraints: UK Monetary Policy Reaction Functions, 1985–2003" Oxford Bulletin of Economics and Statistics, Vol.67, no.4, pp. 0305-9049.

Al-Mashat, R. and Billmeier, A. (2007), "The Monetary Transmission Mechanism in Egypt", Working Paper no. WP/07/285. IMF, Washington, D.C.

Amano, Robert, Don Coletti, and Tiff Macklem, "Monetary Rules when Economic Behaviour Changes," April 1999. Bank of Canada Working Paper 99-8.

Batini, N. and J. Pearlman (2002), "Too Much Too Soon: Instability and Indeterminacy with Forward-Looking Rules", Bank of England, External MPC Unit, Discussion Paper no 8.

Batini, Nicoletta and Andrew Haldane, "Forward-Looking Rules for Monetary Policy," in John B. Taylor, ed., Monetary Policy Rules, Chicago: University of Chicago Press, 1999, pp. 157–192.

Bernanke, Ben S. Laubach, T., Mishkin, F.S. and Posen, A.S., (1999), "Inflation Targeting: Lessons from the International Experience". Princeton, NJ: Princeton University Press.

Bernanke, Ben S., and Mishkin, F. S., (1997) "Inflation targeting: A new framework for monetary policy". Journal of Economic Perspectives 11 (2), pp. 97-116.

Bjørnland, Hilde; Brubakk, Leif; Jore, Anne (2008), "Forecasting inflation with an uncertain output gap". Empirical Economics, Vol. 35, N°3, pp.413-436.

Blanchard O. J. and D. Quah (1989), "The dynamic effect of aggregate demand and supply disturbances". American Economic Review, Vol 79 N°4, pp.655-673

Boughrara, A., Boughzala, M. and Moussa, H., (2008) "Credibility of Inflation Targeting in Morocco and Tunisia", FEMISE Workshop "Monetary Policy and Inflation Targeting", 24th-25thOctober 2008, Tunis, Tunisia.

Clarida, R., Galí, J. and Gertler, M. (2000), "Monetary Policy Rule and Macroeconomic Stability: Evidence and Some Theory," Quarterly Journal of Economics.

Clarida, R. and J. Gali, (1994), "Sources of Real Exchange Rate Fluctuations: How Important Are Nominal Shocks?," Carnegie-Rochester Conference Series on Public Policy, 41, pp.1-56.

Clarida, R., Gali, J., and M. Gertler, (1998), 'Monetary Policy Rules in Practice: Some International Evidence', European Economic Review, 42, pp1033-1067.

Claus, I., P. Conway and A. Scott (2000), "The output gap: measurement, comparisons and assessment", Reserve Bank of New Zealand Research Paper N°. 44

De Mello. L and Moccero. D, (2008) "Monetary policy and macroeconomic stability in Latin America: The cases of Brazil, Chile, Colombia and Mexico", in "Monetary Policies and Inflation Targeting in Emerging Economies" edited by Luiz de Mello, pp. 25-41.

Debelle, Guy and Stanley Fischer (1994). "How Independent Should a Central Bank Be?" in Jeffrey C. Fuhrer, ed., Goals, Guidelines, and Constraints Facing Monetary Policymakers, Conference Series 38 (Boston: Federal Reserve Bank of Boston), pp. 195-221.

Doménech, R., Ledo, M. and Taguas, D. (2001) 'A small forward-looking macroeconomic model for the EMU' BBVA working paper, 2/2001.

DeSerres, A., A. Guay, and P. St-Amant (1995), "Estimating and Projecting Potential Output Using Structural VAR Methodology: The Case of the Mexican Economy", Working Paper, 95-2, Bank of Canada, Ottawa.

Forum Euro-méditerranéen des Instituts de Sciences Economique workshop: (FEMISE) (2008), "Monetary Policy and Inflation Targeting", 24th-25thOctober 2008, Tunis, Tunisia. (http://www.femise.org/activites/workshop/index-Tunisia-fr.html)

Florens, C., Jondeau, E. and Le Bihan, H., (2001) "Assessing GMM Estimates of the Federal Reserve Reaction Function".

Fritsche, U. and C. Logeay (2002), Structural Unemployment and the Output Gap in Germany: Evidence from an SVAR Analysis Within a Hysteresis Framework, DIW Discussion Paper No. 312, Berlin.

Galí, J., Gertler, M. and López-Salido, D (2001) "European Inflation Dynamics". European Economic Review.

Gerlach, S. and Schnabel, G. (2000), "The Taylor Rule and Interest Rates in the EMU Area", Economics Letters 67, pp. 165-171.

Glenn, R., and Svensson. Lars. E. O. (1998) "Policy Rules for Inflation Targeting." Paper presented at the NBER Conference on Monetary Policy Rules, pp.15-17.

Hansen, L., (1982) "Large sample properties of generalized method of moments estimators. Econometrica , Vol.50, pp. 029-1054.

Harvey A.C., and A. Jaeger (1993), "Detrending, Stylized Facts and the Business Cycle", Journal of Applied Econometrics, Vol. 8, pp.231-247.

Hauptmeier, S., et al. (2009), "Projecting Potential Output, Zew Economic Studies, DOI: 10.1007/978-3-7908-2177-2_1.

International Monetary Fund, (2006) "Inflation Targeting and the IMF", Washington, D.C.

King, M. (1997), "The Inflation Target Five Years On", Bank of England Quarterly Bulletin, 37(4), pp. 434-442.

King, M. (2005) "What has inflation targeting achieved?", in Bernanke, Ben S., and Michael Woodford, eds. (2005), The Inflation-Targeting Debate, University of Chicago Press, 11-16.

Kuttner, K. (2004), "The role of policy rule in inflation targeting", Federal Reserve Bank of Dt. Louis Review, pp.88-111.

Levin, A., V. Wieland and J.C. Williams (2001), "The Performance of Forecast-Based Monetary Policy Rules under Model Uncertainty", American Economic Review, June 2003, Vol. 93, (3), pp. 622-45.

Masson, P., Savastano, M.A., Sharma, S., (1997) "The Scope for Inflation Targeting in Developing Countries", IMF Working Paper WP/97/130.

Mishkin, F.S., (2002) "Inflation Targeting", in Howard Vane and Brian Snowdon, editors, Encyclopedia of Macroeconomics, Edward Elgar: Cheltenham U.K., pp. 361-65.

Mishkin, F.S., (2004) 'Can Inflation Targeting Work in Emerging Market Countries?'. Paper presented to a conference in honour of Guillermo Calvo, April. Washington: International Monetary Fund.

Mishkin, Frederic S. and Posen, Adam S. A. (1997) "Inflation Targeting: Lessons from Four Countries", Federal Reserve Bank of New York Economic Policy Review, August, pp. 9-110.

Rudebusch, Glenn D., and Lars E.O. Svensson (1999), "Policy Rules for Inflation Targeting," in Taylor (1999), pp. 203–246.

Schaechter, A., Stone, M. R., and Zelmer, M. 2000. Adopting inflation targeting: Practical issues for emerging market countries. IMF Occasional Paper no. 202. Washington, D.C.: International Monetary Fund.

Svensson, Lars E. O. (1997a) "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets." European Economic Review, Vol. 41, no. 6, pp. 1111-46.

Svensson, Lars E. O. (1997b) "Inflation targeting: Some Extension", NBER working Paper (5962).

Svensson, Lars E.O. (1999) "Inflation Targeting as a Monetary Policy Rule." Journal of Monetary Economics, 43(3), pp. 607-54.

Svensson, Lars E.O. (2002), "Inflation Targeting: Should It Be Modeled as an Instrument Rule or a Targeting Rule?" European Economic Review, Vol 46, no. 4–5, pp. 771–80.

Svensson, Lars E.O. (2003), "What is wrong with Taylor Rules?", Journal of Economic Literature XLI(2), 426-477.

Svensson, Lars E.O. (2005), "Monetary Policy with Judgment: Forecast Targeting," International Journal of Central Banking 1(1), 1-54

Svensson, Lars E.O. (2009) "Transparency under Flexible Inflation Targeting: Experiences and Challenges," Sveriges Riksbank Economic Review, pp. 5-44

Svensson, Lars E.O and Woodford, M (2005), "Implementing Optimal Policy through Inflation-Forecast Targeting", in Bernanke, Ben S., and Michael Woodford, eds. (2005), The Inflation-Targeting Debate, University of Chicago Press, pp. 19-83.

Walsh, C. (2007). 'Optimal economic transparency', International Journal of Central Banking, Vol3, issue 1, pp.5–36.

Table 1: Data Description

Data	Description	Source
i_t	The short-run nominal interest rate defied in the monetary market rate (MMR) for Tunisia and Morocco and the discount rate (DR) for Egypt, base (100=2000).	The IMF CD-ROM, December 2009.
GDP_d	Domestic Gross Domestic Product (Tunisia, Morocco and Egypt).	The quarterly frequency is obtained using the ECOTRIM software through the annual frequency from the IMF CD-ROM, December 2009.
GDP_f	Foreign Gross Domestic Product (France and U.S.A).	The IMF CD-ROM, December 2009.
CPI	The consumer price index, base (2000=100)	The IMF CD-ROM, December 2009, and the National Institute of Statistics for Tunisian data.
Inf	The quarter-to-quarter CPI inflation rate	Author calculation.
e_t	Nominal Effective Exchange Rate (NEER) for Tunisia and Morocco and the exchange rate of the Egyptian pounds/U.S dollar (market rate) for Egypt.	The IMF CD-ROM, December 2009.
y_t	The output gap defined as the difference between the real output and the potential output. The estimation of the potential output is obtained by the HP filter and the Structural Vector autoregressive (SVAR) model. See Appendix D.	The IMF CD-ROM, December 2009.
r_t	The real short-run interest rate measured as the difference between the i_t and the inflation rate (for Tunisia, Morocco and Egypt).	The IMF CD-ROM, December 2009.
r_t^*	The foreign real short-term interest rate measured as the difference between the nominal short run interest rate and the inflation rate (France and U.S.A).	The IMF CD-ROM, December 2009.
r^*	The long-run real equilibrium interest rate is obtained by the regression of the real interest rate on a constant and the nominal exchange rate depreciation. The sample considered in the case of Tunisia1984:1-2009:4 ($r^* = 3.05$), for Morocco: 1990:1-2009:4 ($r^* = 2.47$) and for Egypt: 1958:1-2009:4 ($r^* = 1.10$).	Author calculation
π^*	The inflation target equal to 2% following the commonly used value.	The IMF CD-ROM, December 2009.

Table 2: Macroeconomic Model Estimation

	Phillips curve equation			Output gap equation			Exchange rate equation	
	k	***α***	***γ***	***λ***	***β***	***δ***	***μ***	***ω***
Tunisia	0.533***	3.939**	0.011	0.917***	-0.004	-0.003	1.001***	0.003***
	13.350	**2.349**	**1.054**	**6.158**	**-1.105**	**-1.497**	**4,204.220**	**3.150**
	(0.040)	(1.677)	(0.010)	(0.149)	(0.003)	(0.002)	(0.000)	(0.001)
	J-stat $\chi 2$ (18) = 6.866 [0.991]			*J*-stat $\chi 2$ (33) = 43.96 [0.096]			*J*-stat $\chi 2$(13) = 15.39 [0.283]	
Morocco	0.770***	7.486***	-0.024	0.521***	0.005***	0.002	0.948***	-0.061
	8.175	**3.108**	**-1.277**	**10.595**	**3.220**	**1.316**	**19.384**	**-1.008**
	(0.094)	(2.408)	(0.019)	(0.049)	(0.001)	(0.001)	(0.049)	(0.060)
	J-stat $\chi 2$ (19) = 29.168 [0.063]			*J*-stat $\chi 2$ (30) = 26.976 [0.624]			*J*-stat $\chi 2$ (13) = 7.266 [0.887]	
Egypt	0.511***	-58.066***	0.070	0.843***	0.005*	0.001	0.995***	-0.004
	3.750	**-2.808**	**0.803**	**8.716**	**1.848**	**0.659**	**481.986**	**-1.091**
	(0.136)	(20.682)	(0.088)	(0.097)	(0.003)	(0.001)	(0.002)	(0.004)
	J-stat $\chi 2$ (18) = 16.127 [0.583]			*J*-stat $\chi 2$ (27) = 28.80 [0.370]			*J*-stat $\chi 2$ (13) = 16.275 [0.235]	

Notes: *** : significance at 1%; ** : significance at 5%; *: significance at 10% ; Bold numbers are the T-student statistic. The number into parenthesis is the standard errors; The number in brackets is the p-value for the test where the null hypothesis is that the over identifying restrictions are satisfied· *J,* is asymptotically 2 with degrees of freedom equal to the number of over-identifying restrictions (number of instruments less estimated parameters).

Table (3): Taylor rule OLS estimation: Type I: $i_t = {r^*}_t + \pi_t + \theta_\pi[\pi_t - \pi^*]$ Type II: $i_t = {r^*}_t + \pi_t + \theta_\pi[\pi_t - \pi^*] + \theta_y y_t$

	Type I	Type II			
	θ_π	θ_π		θ_y	
Tunisia	-0.005	-0.005		-1.761	
	[-0.083]	[-0.078]		[-0.358]	
	(0.066)	(0.066)		(4.918)	
			R^2= 0.000		R^2 = 0.002
Morocco	-0.951***	-0.950***		0.577	
	[-4.059]	[-4.031]		0.133]	
	(0.234)	(0.236)		(4.330)	
			R^2 = 0.174		R^2 = 0.175
Egypt	-0.913***	-0.919***		-2.172	
	[-15.707]	[-16.272]		[-0.711]	
	(0.058)	(0.057)		(3.053)	
			R^2 = 0.762		R^2=0.764

Notes: *** : significance at 1%; ** : significance at 5%; *: significance at 10% ; The number into brackets is the T-student statistic and the number in parenthesis is the standard errors.

Appendix A: Taylor rule and derivatives

Rule	Country	Estimation	
		Method	Results
Taylor rule (1993): $i_t = r^* + \pi_t + \beta_\pi(\pi_t - \pi^*) + \beta_y y_t$ **r***: The equilibrium real interest rate. $\boldsymbol{\pi}_t$: 12 month inflation. $\boldsymbol{\pi}$: inflation target. $\mathbf{y}_t$: output gap.	USA: 1987-1992 (Federal funds rate)	OLS	No formal econometric study was performed, and the rule in equation (1) was found simply to visually track the federal funds rate fairly well between 1987 and 1992.
Taylor rule (199b): $i_t = \delta + \beta_\pi \pi_t + \beta_y y_t + \varepsilon_t$ δ: r* - (βπ - 1)π*	-USA: the international gold standard era. -Bretton Woods era- post Bretton Woods era. -USA: 1965-1979, 1979-1987, and 1987-1999.	OLS	Taylor finds the size of response coefficients had increased over time. Hetzel (2000) also found that the response coefficients increased over time but questioned whether these should be given structural interpretations.
Orphanides (2001): $i_t = \alpha + \beta_\pi[E_t(\pi_{t+k}) - \pi^*] + \beta_y E_t(y_{t+m})$	USA: 1987-1992.	Last squares and instrumental variable estimation using exponential real time data.	The estimated rules provided a much less accurate description of policy when real time rather than ex-post data. Forward-looking Taylor's rule version performs well when using real time data.
$i_t = \alpha + \beta_\pi(\pi_t - \pi^*) + \beta_y y_t$ $i_t = \alpha + \beta_\pi[E_t(\pi_{t+k}) - \pi^*] + \beta_y E_t(y_{t+m}) + \rho i_{t-1}$	New Zealand: 1989-1998.		Huang t al (2001) found the same result.

Rule	Country	Estimation	
		Method	Results
$i_t = (1-\rho)\{\alpha + \beta_\pi[E_t(\pi_{t+k}) - \pi^*] + \beta_y E_t(y_{t+m})\} + \rho i_{t-1}$	Germany, Japan, the USA, the UK, France and Italy: 1979-1992.	GMM	Clarida et al. (1998) find that central banks are not only forward looking but also apply a surprisingly high degree of interest rate smoothing.
$i_t = (1-\rho)\{\alpha + \beta_\pi[E_t(\pi_{t+k}) - \pi^*] + \beta_y E_t(y_{t+m})\} + \rho i_{t-1}$	USA: 1960-1979 and 1979-1996.	GMM	Clarida et al. (2000) response coefficients, including that on the lagged interest rate, differed substantially across the periods.
$i_t = (1-\rho)\{\alpha + \beta_\pi[E_t(\pi_{t+k}) - \pi^*] + \beta_y E_t(y_{t+m})\} + \rho i_{t-1}$	USA EMU area		Doménech et al. (2002) supported the forward-looking rule with interest rate smoothing.
$i_t = \alpha + \beta_\pi(\pi_t - \pi^*) + \beta_y y_t$ $i_t = (1-\rho)\{\alpha + \beta_\pi[E_t(\pi_{t+k}) - \pi^*] + \beta_y E_t(y_{t+m})\} + \rho i_{t-1}$	EMU: 1990-1998.	GMM	Gerlach and Schnabel (2000) monetary policy in the EMU area had largely been consistent with the Taylor- rule.

Appendix B: Data description

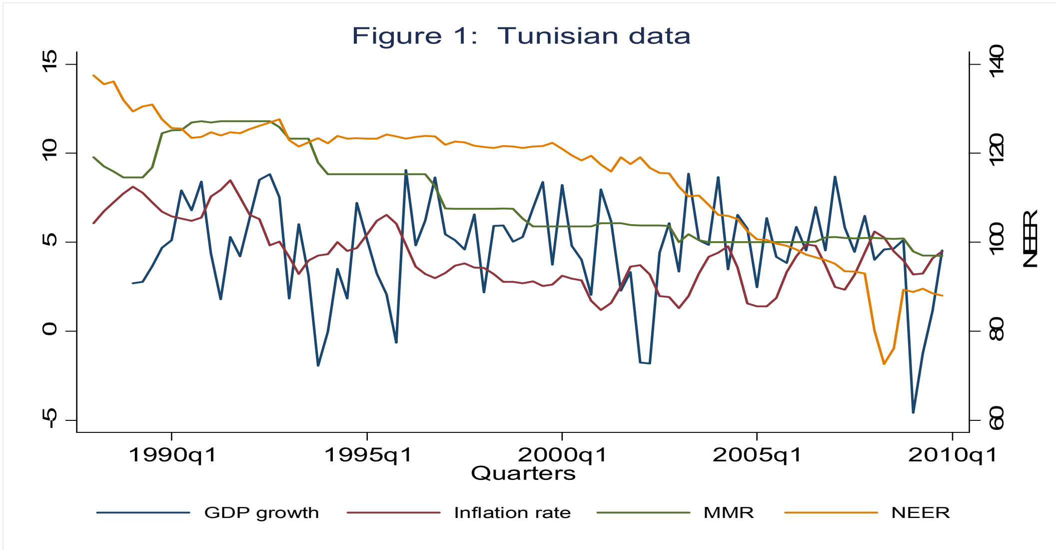

Figure 1: Tunisian data

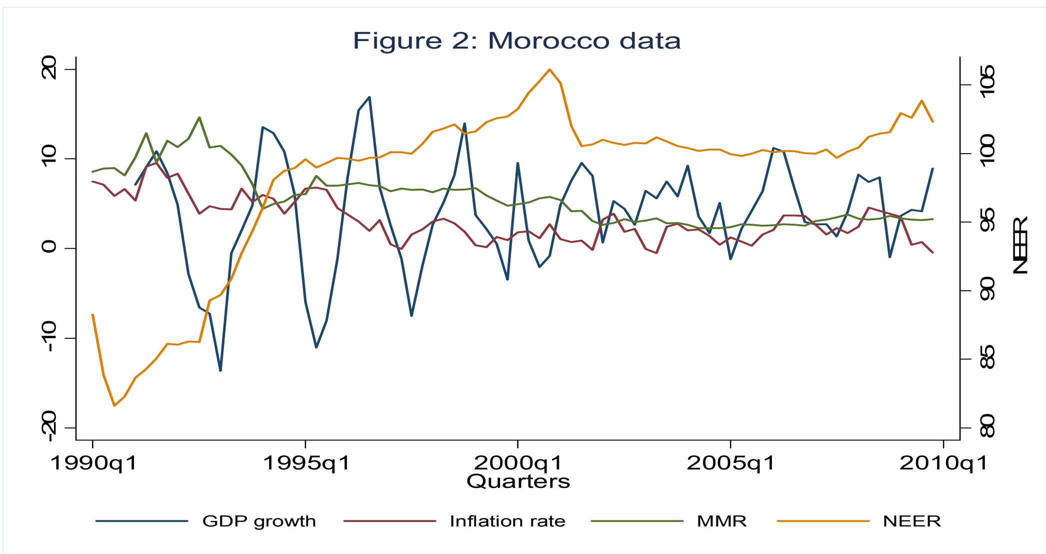

Figure 2: Morocco data

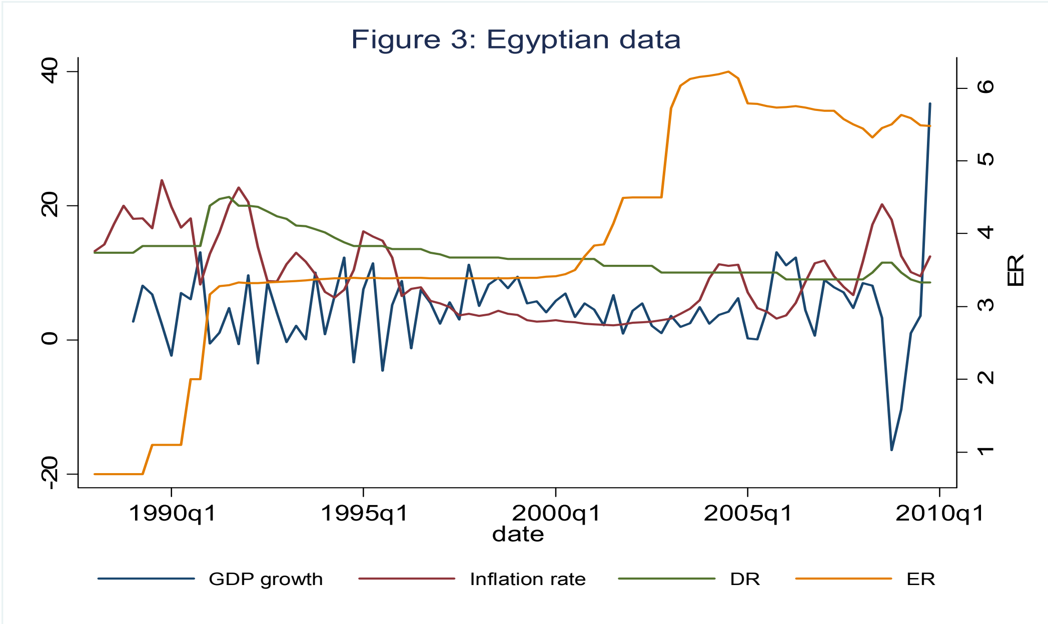

Figure 3: Egyptian data
40
20
0
-20
6
5
4
3
2
1
ER
1990q1
1995q1
2000q1
2005q1
2010q1
date
GDP growth
Inflation rate
DR
ER

Appendix C: Table c: Instrumental variables for GMM estimation

	Tunisia	Morocco	Egypt
PC curve	-Four lags of inflation rate, output gap, real effective exchange rate, and nominal exchange rate depreciation. -One lag of world commodity price index.	-Four lags of inflation rate, output gap, real effective exchange rate, and nominal exchange rate depreciation. -One lag of world commodity price index and nominal interest rate.	-Four lags of inflation rate, output gap, real exchange rate, nominal exchange rate depreciation -One lag of word commodity price index.
AD curve	-Four lags of inflation rate, output gap, real effective exchange rate and nominal interest rate. -Three lags of credit government from monetary authorities. -Two lags of general government consumption expenditure, nominal exchange rate depreciation, foreign direct investment net inflows and gross fixed capital formation. -Long-run real equilibrium interest rate and the inflation target.	-Four lags of inflation rate, output gap, real effective exchange rate, nominal interest rate and foreign direct investment net inflows, nominal interest rate. -Three lags of credit government from monetary authorities. -Two lags of general government consumption expenditure, nominal exchange rate depreciation, foreign direct investment net inflows and gross fixed capital formation.	-Four lags of inflation rate, output gap, nominal exchange rate and foreign direct investment net inflows and deposit rate. -Two lags of general government consumption expenditure, nominal exchange rate depreciation. -Long-run real equilibrium interest rate and inflation target.
Exchange rate	-Four lags of nominal effective exchange rate and inflation rate and real effective exchange rate.	-Four lags of nominal effective exchange rate and inflation rate and real effective exchange rate	-Four lags of the nominal exchange rate, inflation rate and real exchange rate.

Appendix D: Output gap and potential output: Table d1: The common measures of the potential output and output gap

	Statistical approach		Structural approach
	Univariate	Multivariate	Multivariate
Methods	Filtre Hodrick Prescott	Filtre Hodrick Prescott	Structural VAR
	Filtre Baxter et King	Beveridge et Nelson	Production Function Approach
	Filtre Christiano Fitzgerald	Unobservable components	
	Unobservable components		

Potential output and output gap:

Okun (1962) defined the concept of potential output in non-inflationary framework, as the maximum production attainable by the economy. Hence, potential output describes the "steady state" of the economy given by the level of the economic activity under the condition of full capacity utilization (labor force, labor productivity and labor participation) without inflationary effects.

The output gap is defined as the deviation of the actual GDP from its potential level. It indicates macroeconomic efficiency (when the gap is positive) and inefficiency (when the gap is negative). The output gap is considered as an indicator for future inflationary pressure. Claus et al (2000) found that the output gap inform well about the direction of inflationary pressures using the expectations augmented Phillips curve for New Zealand. In the case of Norway, Bjørnland et al (2008) employ a Phillips-curve-type with multivariate measure of the output gap. Their models were found to forecast accurately inflation than an AR benchmark model. A wide range of output gap-based forecasting models applied to the United States in Orphanides and Van Norden (2005) was found to perform well than an AR benchmark model.

With regard to fiscal and monetary policy, potential output and output gap are key variables. Since they express the excess demand or supply, they have a bearing on the cyclical position of the economy. Indeed, for monetary policy demand excess (supply excess) with an expansionary (contractionary) monetary regime brings about business cycle amplification. For fiscal policy, the potential output and the output gap contain information to gauge the cyclical development effects on the budget deficits, thus on the government's fiscal strategy (via the determination of the cyclically adjusted balance), see Gibbs (1995) and Koske and Pain (2008) about the usefulness of the potential output and the output gap, among many others[19].

Measures of the potential output and the output gap:

Many measures were provided by the empirical studies[20]. These techniques can be divided into two categories; statistical and structural approaches with univariate and multivariate methods see table d1. The former decompose the output into its trend (potential output) and cyclical (output gap) components. The latter, since are based on the economic relationships that link the potential output and the relevant variables, they allow for drawing insightful information in respect to the policies' projections. Therefore structural methods are preferred to statistical ones, Cotis et al. (2003) criticized the methods measuring the potential output

[19] For more theoretical and empirical details of potential output see Hauptmeier, S et al (2009) "Projecting Potential Output", ZEW Economic Studies.

[20] Bukhari, S. Adnan H. A. S. and Khan, S. U (2008) in appendix: table A 1 reviewed thoroughly the different measures of potential output and output gap (Data, variables and findings) from 1995 until 2005 for many countries.

used in the literature and revealed the superiority of structural methods, as methods with less shortcomings, comparing to statistical ones.

The statistical univariate technique considered in our study is the filter proposed by Hodrick-Prescott (1997) (HP filter henceforth). Its wide use is motivated by its easy implementation. Indeed the HP filter consider that the time series y_t is the sum of cyclical y_t^{gap} and growth components y_t^{pot}, and make the assumptions of the "smoothness" of the growth component measured as the sum squared of its second difference and of the near zero average of the gap over long time period. The potential output is then obtained by minimizing a loss function:

$$\min L = \sum_{t=1}^{T} \left(y_{gap}\right)^2 + \lambda \sum_{t=2}^{T} \left(\Delta y_{pot_t} - \Delta y_{pot_{t-1}}\right)^2$$

Where T is the number of observations and λ is the smoothing parameter that indicate the penalty attributed to the deviation of the growth component, that is, when λ has larger values more smoother are the series detrended and less is the gap calculated. But when λ approaches infinity the loss function is reduced to a linear trend model hence the solutions are the last squares estimates. Of course, when λ approaches zero, the potential output will be equal to the actual output.

The series of output gap obtained using the HP filter have the advantage to be are stationary, however this method has also its shortcomings. First, there is the choice of the smoothing parameter, which is based on the most used values. Second, the high end-of-sample bias which impedes the HP filter to be symmetric given the lack of leads and lags towards the edges of the sample and then offsets the informative content that the last observations are expected to deliver to the policy makers. To avoid this problem, the remedy is to extend the sample that is to forecast accurately the output series. Finally, the Hp filter is found to generate a spurious cycles that did not exist in the original data especially when data are integrated or nearly integrated, see Harvey and Jaeger (1993).

The structural multivariate technique employed here is the structural Vector autoregressive (SVAR) method based on Blanchard and Quah (1989) whom proposed a bivariate SVAR model to estimate the effects of the aggregate supply and demand shocks on output and unemployment. This method identifies the fluctuations of output and unemployment as due to demand and supply shocks. It rests on assumptions that the supply disturbances have permanent effects on output while the effects stem from the demand side are temporary.

To overcome the critics of Blanchard and Quah (1989) bivariate model, many studies extended it to trivariate SVAR. Clarida and Gali (1994) estimate potential output using output, real exchange rate and price level for Germany, Japan, Canada and Britain. DeSerres, Guay, and St-Amant (1995) consider industrial production, oil price and the money supply as dependent variables for Mexico. Fritsche and Logeay (2002) employ the real wage development besides output and unemployment for Germany. The model for New Zealand proposed by Claus (2003) contains real GDP, full-time employment, and capacity of utilization and oil price. Recently the model of Bjørnland et al (2008) includes output, unemployment and inflation to estimate Norway's output gap.

In this study, the SVAR model incorporates output, real exchange rate and inflation. A bivariate model will be performed consistent with Blanchard and Quah (1989) as well as a trivariate model as an extension of the former. According to this approach the potential output accounts for the sum of supply disturbances and the output gap for the sum of the aggregate demand disturbances, therefore the objective of the SVAR procedure is to identify these disturbances. To do so, consider X_t a vector composed from output Y_t, exchange rate

$NEER_t$ and inflation INF_t. As the endogenous variables are a linear combination of past and current shocks, their sequence can be expressed as a SVMA system of the SVAR model:

$$\begin{pmatrix} y_t \\ NEER_t \\ INF_t \end{pmatrix} = \begin{pmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{24}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{pmatrix} \begin{pmatrix} d_{1t} \\ d_{2t} \\ d_{3t} \end{pmatrix} \qquad (1)$$

Where d_{1t}, d_{2t} and d_{3t} are uncorrelated white noise supply and demand disturbances respectively. The coefficient of the lag polynomial A (L) represent the impulsive response of shocks on endogenous variables. Another way to write equation (1) is:

$$x_t = A(L)d_t \qquad (2)$$

Where $x_t = [\Delta y_t \quad NEER_t \quad INF_t]'$ and $d_t = [d_{1t} \quad d_{2t} \quad d_{3t}]'$ are serially uncorrelated normalized shocks with a variance-covariance matrix equal to identity, such that; $E\,(d_t d'_t) = I$.

The vector of structural disturbances is not observable, to counter this problem; first an unrestricted reduced VAR system is estimated,

$$\begin{pmatrix} y_t \\ NEER_t \\ INF_t \end{pmatrix} = \begin{pmatrix} \Phi_{11}(L) & \Phi_{12}(L) & \Phi_{13}(L) \\ \Phi_{21}(L) & \Phi_{22}(L) & \Phi_{24}(L) \\ \Phi_{31}(L) & \Phi_{32}(L) & \Phi_{33}(L) \end{pmatrix} \begin{pmatrix} \Delta y_{t-1} \\ RER_{t-1} \\ INF_{t-1} \end{pmatrix} + \begin{pmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \end{pmatrix}$$

Or $\quad x_t = \Phi(L)x_{t-1} + \mu_t \qquad (3)$

The VAR estimation, assuming that the variables are stationary, can be inverted to VMA estimation (Wold decomposition):

$$x_t = B(L)\,\mu_t \qquad (4)$$

With $B(L) = (1 - \Phi(L)L)^{-1}$ and $E(\mu_t \mu'_t) = \Sigma$

$$\Sigma = \begin{pmatrix} \mathrm{var}(\mu_{1t}) & \mathrm{cov}(\mu_{1t}, \mu_{2t}) & \mathrm{cov}(\mu_{1t}, \mu_{3t}) \\ \mathrm{cov}(\mu_{2t}, \mu_{1t}) & \mathrm{var}(\mu_{2t}) & \mathrm{cov}(\mu_{2t}, \mu_{3t}) \\ \mathrm{cov}(\mu_{3t}, \mu_{1t}) & \mathrm{cov}(\mu_{3t}, \mu_{2t}) & \mathrm{var}(\mu_{3t}) \end{pmatrix}$$

The assumption that the innovations of the reduced form and the structural shocks are connected imply that

$$\mu_t = A(0)\,d_t \qquad (5)$$

With $E(\mu_t \mu'_t) = A(0)E(d_t d'_t)A'(0) = \Sigma$, where A(0) 3x3 matrix expresses the contemporaneous effects of the structural shocks d_t on x_t, identifying A(0) leads to recover the structural shocks via the innovations μ_t.

The symmetric matrix $\boldsymbol{\Sigma}$ provides six equations in the nine unknown

$$\Sigma = \begin{pmatrix} A_{11}(0)^2 + A_{12}(0)^2 + A_{13}(0)^2 & A_{11}(0)A_{21}(0) + A_{12}(0)A_{22}(0) & A_{11}(0)A_{31}(0) + A_{13}(0)A_{33}(0) \\ A_{11}(0)A_{21}(0) + A_{12}(0)A_{22}(0) & A_{21}(0)^2 + A_{22}(0)^2 + A_{23}(0)^2 & A_{22}(0)A_{32}(0) + A_{23}(0)A_{33}(0) \\ A_{11}(0)A_{31}(0) + A_{13}(0)A_{33}(0) & A_{22}(0)A_{32}(0) + A_{23}(0)A_{33}(0) & A_{31}(0)^2 + A_{32}(0)^2 + A_{33}(0)^2 \end{pmatrix}$$

The equation (2), (4) and (5) imply that;

$$\begin{pmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{pmatrix} = \begin{pmatrix} B_{11}(L) & B_{12}(L) & B_{13}(L) \\ B_{21}(L) & B_{22}(L) & B_{23}(L) \\ B_{31}(L) & B_{32}(L) & B_{33}(L) \end{pmatrix} \begin{pmatrix} A_{11}(0) & A_{12}(0) & A_{13}(0) \\ A_{21}(0) & A_{22}(0) & A_{23}(0) \\ A_{31}(0) & A_{32}(0) & A_{33}(0) \end{pmatrix}$$

Or $$A(L) = B(L)A(0)$$

and by imposing the restrictions that demand shocks have no permanent effect on output that is $A_{12}(L) = A_{13}(L) = A_{23}(L) = 0$, what makes A(L) low triangular, we get three missing equations:

$A_{12}(L) = B_{11}(L)A_{12}(0) + B_{12}(L)A_{22}(0) + B_{13}(L)A_{32}(0)=0$

$A_{13}(L) = B_{11}(L)A_{13}(0) + B_{13}(L)A_{23}(0) + B_{13}(L)A_{33}(0)=0$

$A_{23}(L) = B_{21}(L)A_{13}(0) + B_{22}(L)A_{23}(0) + B_{23}(L)A_{33}(0)=0$

Once A(0) is identified and the structural shocks are recovered, the temporary and cyclical components of output can be obtained as follow:

$$\Delta y = S_{11}(L)d_{t1} + S_{12}(L)d_{t2} + S_{13}(L)d_{t3}$$
$$= \Delta y_t^{pot} \quad + \Delta y_t^{gap}$$

Estimation of potential output and the output gap

The estimates use quarterly seasonally adjusted data for the GDP, NEER and inflation. The quarterly figure of GDP is obtained by temporal disaggregation methods using the ECOTRIM software developed by Eurostat. The smoothing parameter of HP filter is set equal to 1600 for quarterly data. The GDP growth, inflation and the NEER are shown in figure 2

To perform the SVAR procedure, the stationarity of the variables included in the model need to be checked over. We consider the augmented Dicky-Fuller (1984) test (ADF) and the Phillips-Perron (1988) (PP) with null hypothesis that the series has a unit root.

The GDP integration results, confirmed by the two tests, show that GDP series are first difference stationary for Tunisia and Morocco and Egypt GDP is third differenced. The ADF test suggests that the Nominal Effective Exchange Rate is first difference stationary for the three countries; this result is also confirmed by the PP test. The inflation integration tests indicate that the series are first difference stationary for the three countries. Hence, the VAR model is estimated as difference of the logarithms.

Table d2: Stationarity tests

	variables		ADF[a]		PP[b]	
			No trend	trend	No trend	trend
Tunisia	GDP	level	-0.678(4)	-3.261(4)	-0.030	-11.239*
		Δ	-5.685 (3)*	-5.684(3)*	-84.616*	-84.283*
	NEER	level	1.047(6)	-0.753(5)	-0.349	-1.750
		Δ	-8.00(1)*	-4.403(5)	-7.789*	-8.591*
	INF	Level	-1.950(4)	-1.081(4)	-2.429	-2.859
		Δ	-9.744(3)*	-5.151(11)*	-5.237*	-4.942*
Morocco	GDP	Level	4.537(7)	-0.756(7)	-0.952	-6.011*
		Δ	-1.483(11)	-3.463(11)	-33.258*	-47.942*
		2[cd] Δ	-9.003(10)*	-8.911(10)*	-70.373*	-69.817*
	NEER	Level	-3.284(1)**	-2.265(1)	-1.514	-1.2423
		Δ	-6.871(0)*	-7.237(0)*	-6.872*	-7.271*
	INF	Level	-1.469(4)	-1.746(4)	-2.645	-3.557*
		Δ	-8.409(3)*	-8.347(3)*	-9.622*	-9.557*
Egypt	GDP	Level	0.039(4)	-7.659(1)*	0.707	-7.461*
		Δ	-8.205(3)*	-8.109(3)*	-22.454*	-22.872*
	NEER	Level	-3.966(8)*	-5.330(8)*	-3.281**	-2.285
	INF	Level	-1.746(6)	3)*-0.393(8)	-1.925	-1.989
		Δ	-5.619(4)*	-9.657(3)*	-7.343*	-7.468*

Notes: [a]The initial number of lags is set equal to 11; Critical values are obtained from MacKinnon (1996). Values into parenthesis are the lags defined by the AIC criteria. All the regressions include a constant. [b]The spectral density is estimated with Bartlett Kernel and Newey-West Bandwidth. *H_0 is rejected at 1%. **H_0 is accepted at all levels. ***H_0 of unit root is rejected at the 10% level

The residual serial correlation was eliminated using lags structure that are selected by most of criterion and verify the model stability (no AR roots outside the unit circle) and the basic residual tests (no autocorrelation). The lag is four for Tunisia, five for Morocco and three for Egypt.

Figure d1-d3 depicts the SVAR and HP output gap for the three countries. Tunisian output gap measures appear to be different in the beginning of the 90s. The HP output gap indicates more excess demand or supply than SVAR model; hence the economic conditions had no effect on productivity during that period. For the remaining period both measures follow the same direction.

The output gaps as obtained from the SVAR approach and the HP filter for Morocco. Overall, output gaps are broadly consistent and follow the GDP movement. A little dissimilarity in the beginning of the period, the HP indicates an excess supply or demand more stressed then the SVAR gap.

The SVAR and HP output gaps movements were in perfect match and tracked well the GDP, only during the three first years, they moved in the opposite way. In 1998, excess demand and supply occurred successively. This turmoil is attributed to the fallout of the stabilization program[21], the structural reform and changes in the structural of GDP (services sector, agriculture, manufacturing and petroleum).

[21] The Economic Reform and Structural Adjustment Program (ERSAP) concluded with the IMF in May 1991 and a program with the World Bank in November 1991. See Ikram, K. (2006).

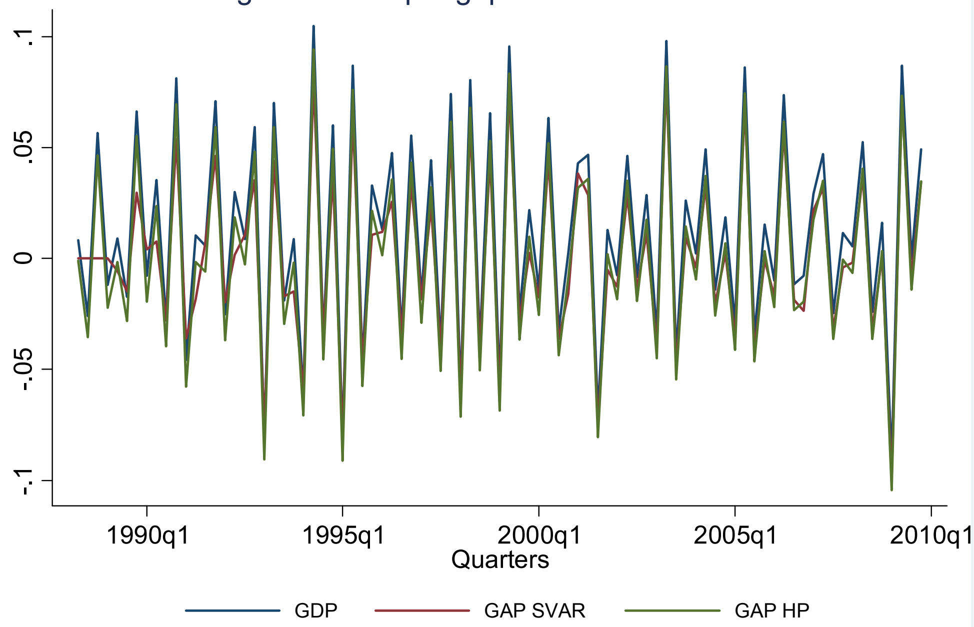

Figure d1: Output gap measures of Tunisia

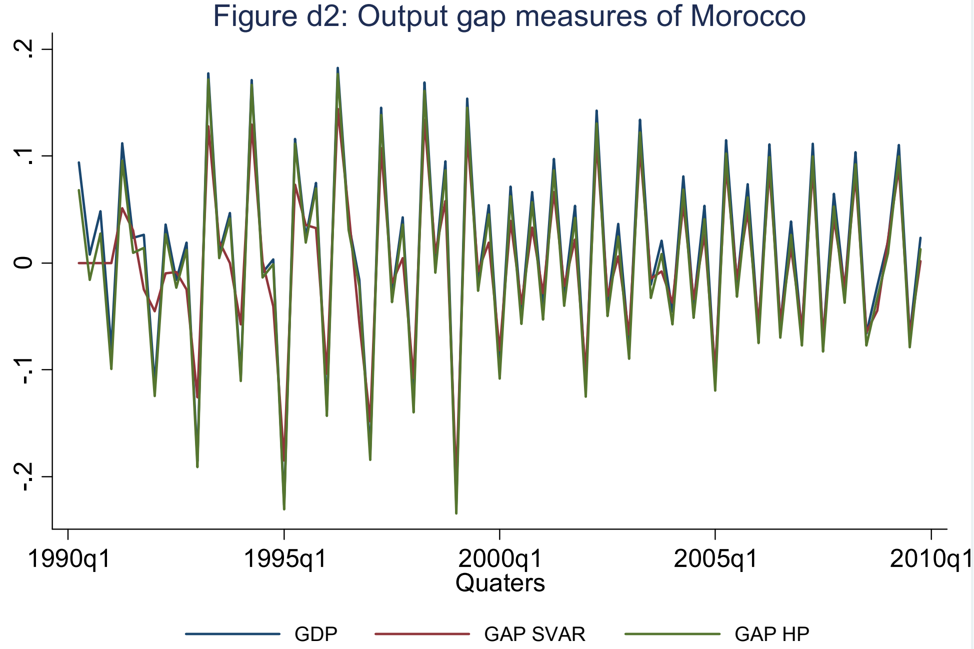

Figure d2: Output gap measures of Morocco

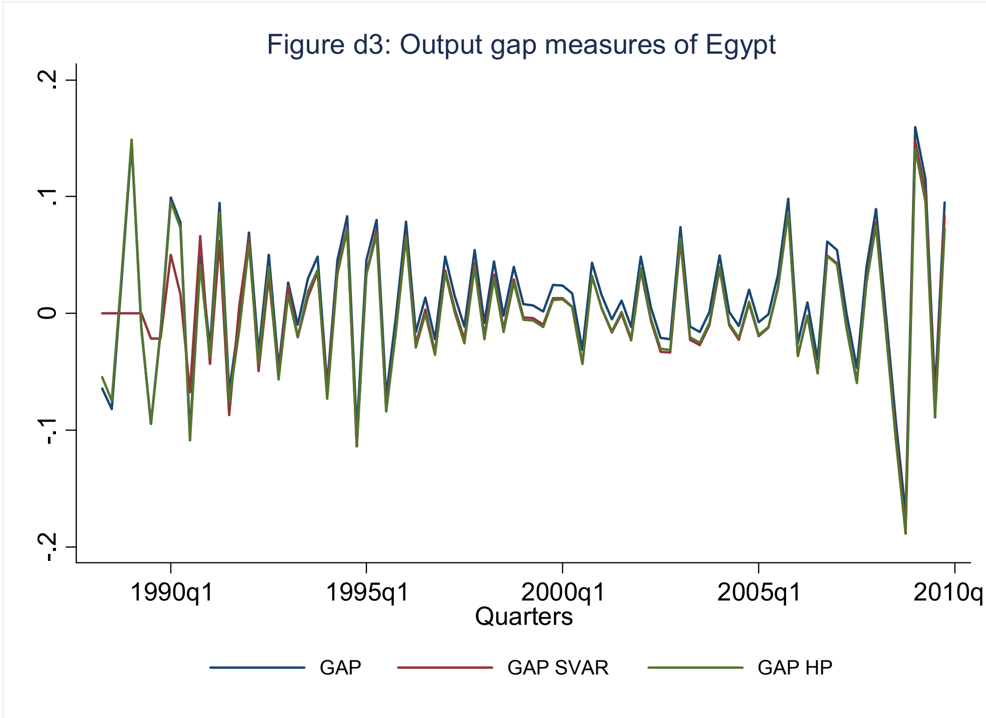
Figure d3: Output gap measures of Egypt
.2
.1
0
-.1
-.2
1990q1
1995q1
2000q1
2005q1
2010q1
Quarters
GAP
GAP SVAR
GAP HP