Analysis of Business Cycles in Turkish Economy*

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Business Cycles, Stabilization, Markov Regime Switching Model.

Abstract
This study focuses on the business cycles in the Turkish economy under the changing economic policy after the deep financial crisis of 2001. This new process started in 2002 was based on three basic structural transformations; budget control, strong banking system and independent central bank. The monetary policy which played a leading role was carried out by the independent central bank in the inflation targeting regime in this process. It is expected that the policy that price stability takes priority will also be effective on output stability. The emergence of two disparate sub-periods under the influence of the global crisis and domestic policy changes has also had an impact on output stability. This created two regimes with different average growth rates. In our study, we examine output stability using 2002-2016 quarterly GDP data. We develop a Markov-switching model which allows a given variable to follow a different time series process over different subsamples. The results show that expansion periods are highly persistent while depression periods are transitory and finite lives.

1. Introduction
In 2001, Turkish economy experienced the deepest crisis in a series of boom-bust episodes in 1990s. After the 2001 crisis the paradigm of economic policy totally was shifted. Along with the structural reforms, the stabilization program was three-pronged. Controlling of the budget, recapitalization of banking system and independency of the central bank. In this period, which started in 2002, an effective economic policy was implemented with the support of structural reforms. Rapid disinflation and high growth rates was experienced in this period. Economic stability, which began to deteriorate gradually with the domestic effects in mid-2006, worsened further in 2008 due to the contagious effect of the global crisis. And at the same time it was the end of this period.

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When we look at Graph 1, which shows the potential output and output gap, we can see that the negative output gap had started to emerge by the end of 2008 and it increased even more in 2009. The economy, which had been on the potential until this turn, fell below its potential in the next period and entered a period of recovery. After experiencing negative growth rates in 2008 and 2009 because of the global crisis, the second positive growth period which has been continuing to today started. This period is the low growth period that is characterized by expansionary fiscal policy and weak monetary policy that allowed inflation to rise and remain elevated, current account deficit to increase and financial markets to suffer high volatility (Gurkaynak et al., 2008).

When we look at Graph 2, it is seen that the frequency of positive growth periods and growth rates are gradually decreasing. The red line we use to show the average growth trend confirms this.

In this study, we model the cyclical behaviour of GDP for Turkish economy. Our aim is to expand on characteristics of expansion and contraction periods. There is substantial interest in modeling the dynamic behavior of macroeconomic and financial time series observed over time. A challenge for this analysis is that these time series likely undergo changes in their behavior over reasonably long sample periods. This change may occur in the form of a “structural break”, in which there is a shift in the behavior of the time series because of some permanent change in
the economy's structure. Alternatively, the change in behavior of the time series might be temporary in the case of economic depressions or financial crises. In short, these shifts might be both temporary or recurrent and behaviour of the time series might cycle between regimes. For example, the behaviour of economic variables can change dramatically in the period of expansion and recession.

One approach to describing this change is to use a "regime-switching" model which allows the parameters of the model to take on different values in each of some fixed number of regimes. Application of regime-switching models are usually motivated by economic phenomena that appear to involve cycling between recurrent regimes. For example, regime-switching models have been used to investigate the cycling of the economy between business cycle phases (expansion and contraction), “bull” and “bear” markets in equity returns, and high and low volatility regimes in asset prices. However, regime switching models need not to be restricted for parameter movement across recurrent regimes. In particular, the regimes might be non-recurrent, in which case the models can capture permanent “structural breaks” in model parameters.

2. Literature Review

There are a number of formulations of regime-switching time-series models in the recent literature, which can be usefully divided into two broad approaches. The first group models regime change as arising from the observed behavior of the level of an economic variable in relation to some threshold value. These 'threshold' models were first introduced by Tong (1983), and are surveyed by Potter (1999). The second group models regime change as arising from the outcome of an unobserved, discrete, random variable, which is assumed to follow a Markov process. These models commonly referred to as "Markov-switching" models. In these 'switching' models were firstly introduced by Goldfeld and Quandt (1973), Cosslett and Lee (1985), two regimes are introduced with a state process determining one of the regimes to take place in each period. The bivalent state process is typically modeled as a Markov chain. The autoregressive model with this type of Markov switching in the mean was first considered by Hamilton (1989), and was further analyzed in Kim (1994). Hamilton and Raj (2002) and Hamilton (2005a) provide surveys of Markov-switching models, while Hamilton (1994) and Hamilton (2016) provide textbook treatments. The primary use of regime-switching models in the applied econometrics literature has been to describe changes in the dynamic behaviour of macroeconomic and financial time series. In particular, regime-switching models which measure output (real Gross Domestic Product (GDP)) have been used to model and identify the phases of the business cycle.

Acikgoz (2008) analyzes the time series behavior of the annual growth rate of Turkey’s GDP and growth rate of its industrial sector GDP. The study examines two series for evidence of periodic, discrete shifts in the mean using a two-state Markov regime switching model. The results provide strong evidence that shifts in the mean of the growth process both general and sectoral are prominent feature of the data. According to probability results, there is one switch between the regimes in general growth process and there are five switches in industrial sector growth process.
Tastan and Yildirim (2008) examines business cycle characteristics of the Turkish economy in the liberalization (post-1980) period using a Markov-Switching Autoregressive (MSAR) model framework. The business cycle properties are found to be very sensitive to the state dimension, the choice of the MS model (classified according to regime-dependent parameters) and the autoregressive lag order. The chosen two-regime MS model suggests four recessionary and five expansionary phases in the post-1980 period. Business cycle phases are found to be asymmetric with the probability of switching from a recession to expansion exceeding the probability of switching from expansion to recession.

Altug and Bildirici (2010) characterizes business cycle phenomena in a sample of 22 developed and developing economies using a univariate Markov regime switching approach. Their study examines the efficacy of this approach for detecting business cycle turning points and for identifying distinct economic regimes for each country in question. It also provides a comparison of the business cycle turning points implied by this study and those derived in other studies and by other methods. Their findings document the importance of heterogeneity of individual countries’ experience.

Barisik et al. (2010) examines the relationship between growth and unemployment in Turkey economy under the Okun Law using Markov Regime Switching Model. They emphasized that Markov Regime Switching Model has more predominant results than linear models. The results show that relationship between variables has asymmetric structure according to economy’s growth and depression periods and Turkey's existing growth doesn’t create employment.

Akgul and Koc (2013) examines the regime structure of Turkey’s economy in the period from the beginning of 1990 to 2007 using Markov switching vector autoregressive (MS-VAR) models. Aim of the study is to determine the regime structure. They use current account, GDP growth rate, ratio of import coverage by export and interest rate series. Their analyze shows the existence of three different regimes in this time period.

Kocaaslan (2016) investigate the nonlinearity and nonstationarity of Turkish output series applying a Markov regime switching augmented Dickey Fuller unit root test. In the study, the output series are characterized by a two-regime Markov switching unit root process. The findings show that output series is stationary in one regime and nonstationary in the other. The nonstationary regime corresponds to recessionary periods in the Turkish economy. That is, the shocks to output are highly persistent in the recession regime, but they are transitory in the expansion regime. In addition, the time period in which the output series is found as stationary is longer than the one in which the output series has a unit root.

3. Empirical Analysis

We carry out our empirical investigation using the log of Turkish quarterly real gross domestic product (GDP) index (2010 = 100) for the period from 2002:Q1 to 2016:Q4. Data are obtained from the Electronic Data Delivery System (EDDS) of the Central Bank of the Republic of Turkey (CBRT).

Regime-switching models are time-series models in which parameters are allowed
to take on different values in each of some fixed number of regimes. In these models, a stochastic process assumed to have generated the regime shifts is included as part of the model, which allows for model-based forecasts that incorporate the possibility of future regime shifts. In certain special situations the regime in operation at any point in time is directly observable. More generally the regime is unobserved, and the researcher must conduct inference about which regime the process was at past points in time.

Following Hamilton (1989) we develop a model which allows a given variable to follow a different time series process over different subsamples. This model is a first-order autoregressive process in which both the constant term and the autoregressive coefficient might be different for different subsamples:

\[ y = c_{st} + \phi_{st} y_{t-1} + \varepsilon_t \]

where \( \varepsilon_t \sim \text{i.i.d. } N(0, \sigma^2) \).

Using that, we model the regime \( s_t \) as the outcome of an unobserved N-state Markov chain with \( s_t \) independent of \( \varepsilon_t \) for all \( t \).

Modelling regime shift, a two-state Markov chain in which state 2 is an absorbing state. The advantage of using a Markov chain over a deterministic specification for such a process is that it allows one to generate meaningful forecast prior to the change that take into account the possibility of change from regime 1 to regime 2.

Markov-switching models also assume that \( s_t \) is an unobserved random variable and follow a particular stochastic process. It is called the state or regime process in date \( t \). Such a process is described as an \( N \) state Markov chains with their transition probabilities as below:

\[ P\{s_t = i | s_{t-1} = j, s_{t-2} = k, ... \} = P(s_t = i | s_{t-1} = j) = p_{ij} \]

The transition probability \( p_{ij} \) gives the the probability that state \( j \) will be followed by state \( i \), and we assume \( \sum_{i=1}^{N} p_{ij} = 1 \). That is, the process indicates a complete probability distribution for \( s_t \). It is convenient to collect the transition probabilities in an \((N \times N)\) matrix \( P \) known as the transition matrix. For a two-state Markov chain, the transition matrix as below:

\[ P = \begin{bmatrix} p_{11} & 1 - p_{22} \\ 1 - p_{11} & p_{22} \end{bmatrix} \]

Suppose that \( p_{11} = 1 \), so that the matrix \( P \) is upper triangular. Then, once the process enters state 1, there is no possibility of ever returning to state 2. In such a case we would say that state 1 is an absorbing state and that the Markov chain is reducible.

Markov-switching models that study business cycles are two-regime models and they capture expansion and recession in the economy. So, \( N = 2 \) and \( s_t = 1, 2 \). We need to impose two restrictions on constant parameter models to estimate Markov-switching models. A first-order, two-regime Markov switching model we use is specified as follows:
where \( \varepsilon_t \sim i.d. N(0, \sigma^2) \). If the regime is low growth, \( s_t=0 \) or \( s_t=1 \), if the regime is high-growth.

### Table 1. MSM(2)-AR(4) model results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coefficient</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-growth regime</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \mu_1 )</td>
<td>1.840659</td>
<td>0.199398</td>
</tr>
<tr>
<td><strong>Low-growth regime</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \mu_2 )</td>
<td>-2.467628</td>
<td>0.637517</td>
</tr>
<tr>
<td><strong>Commons</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \phi_1 )</td>
<td>-0.120875</td>
<td>0.224624</td>
</tr>
<tr>
<td>( \phi_2 )</td>
<td>-0.393470</td>
<td>0.203900</td>
</tr>
<tr>
<td>( \phi_3 )</td>
<td>0.061671</td>
<td>0.165897</td>
</tr>
<tr>
<td>( \phi_4 )</td>
<td>0.095015</td>
<td>0.254139</td>
</tr>
<tr>
<td>( \sigma^2 )</td>
<td>0.292543</td>
<td>0.123851</td>
</tr>
</tbody>
</table>

Table 1 presents estimation output to support that there are two distinct growth-rate phases represent the business cycle. The point estimates for each regime, \( \mu_1 \) and \( \mu_2 \), are statistically different. The average growth rate for the high-growth regime, \( \mu_1 \), significantly positive, while the average growth rate for the low-growth regime, \( \mu_2 \), is significantly positive. High-growth and low-growth regimes of the economy mean growing aggregate output and decreasing aggregate output, respectively.

### Table 2. Estimated Markov probabilities of staying in the same state

<table>
<thead>
<tr>
<th></th>
<th>High-growth regime</th>
<th>Low-growth regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant transition probabilities</td>
<td>0.884161</td>
<td>0.115839</td>
</tr>
<tr>
<td>Constant expected duration</td>
<td>8.632663</td>
<td>1.131016</td>
</tr>
</tbody>
</table>

Table 2 presents probability and duration for each regime. The probability of being high-growth regime is \( p_{11}=0.88 \). It means that the probability that expansion will be followed by another quarter of expansion. The probability of being low-growth regime is \( p_{22}=0.12 \). It means that the probability that contraction will be followed by another quarter of contraction. The results also imply that high-growth regime has a strong persistence. Expected duration for high-growth regime is 8.63 quarters and low-growth regime are 1.13 quarters respectively. High-growth regime persists on average for almost 9 quarters, while low-growth regime persists on average for almost 1 quarter. Thereby, shocks to GDP series are highly persistent in the high-growth regime while they are transitory and they have finite
lives in the low-growth regime.

Figure 3. The smoothed probabilities for low-growth regime

Figure 3 plots inferred probability of a low-growth regime given the available data. When the probability values lie above 0.5, the economy is more likely to be in a recession period. If the probability values lie below 0.5, the economy is more likely to be in expansion period. The regime probabilities are generally very close to 0 and 1. We can say that these turning points predicted by Markov model explicitly indicate one of the regimes. The estimated smoothed probabilities of low-growth regime in Figure 1 clearly correspond to the dates of Turkish recessions.

4. Conclusion

In this paper, we examine the stationarity properties of the Turkish GDP series for the period between 2002:Q1 and 2016:Q4. In doing so, we account for the regime shifts in GDP series by implementing a Markov regime switching model. Application of regime-switching models are usually motivated by economic phenomena that appear to involve cycling between recurrent regimes. We model the cyclical behaviour of GDP and analyse characteristics of expansion and contraction periods. High-growth and low-growth regimes of the economy mean growing aggregate output and decreasing aggregate output, respectively. The results show that shocks to output series are highly persistent in the high-growth regime while they are transitory and they have finite lives in the low-growth regime.
References


