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Modelling and Analyzing Turkish Business Cycles through Markov-Switching Models

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Abstract

This study uses the different versions of the Markov-Switching methodology for modeling business cycles in Turkey and determining their turning points through quarterly real GDP figures for the 1987-2021 period. Based on the results obtained from the models, the recovery periods in Turkey last approximately 8.5 quarters and exhibit long and permanent nature while contraction periods are short, variable, and temporary, lasting around 4 quarters on average. The estimated Markov-Switching models mostly produce the same turning points. The compatibility of the obtained results with the national and international developments experienced during the analyzing period indicates the consistency of the developed models. On the other hand, the results reveal the importance of consistent and credible monetary and fiscal policies in smoothing business cycles.

Keywords: Business cycle, Markov-Switching models, Turkey

JEL Codes: C22, C50, E32.

1. Introduction

The study of business cycles is among the important topics of macroeconomics, and there is a great deal of empirical research to determine the characteristics of business cycles. One of the most important aspects analyzed in said literature corresponds to the characterization of its phases in terms of their duration, persistence, asymmetry, and chronology established from the determination of their turning points. Although the literature analyzing these features is quite extensive, the number of empirical studies related to this subject in detail for Turkey is limited. Despite the existence of studies examining business cycle phases in Turkey from different perspectives and methods, the majority of them focus on dating. Therefore, the number of studies investigating the characteristics of business cycles has been limited and this study aims to contribute to filling this gap.

Although different methods can be used for this purpose, it is possible to say that nonlinear regime change models or Markov-Switching models, which have ideal features in terms of modeling the behavior of business cycles, have come to the fore recently. The main advantage of these models is that they make it possible to determine whether there are different regimes, each with different characteristics, exhibited by the variable that is the subject of the research, and that it can easily associate the determined regimes as expansion and contraction phases.

By employing real GDP data, this study uses different versions of the Markov-Switching model proposed by Hamilton (1989) for modeling business cycles and determining their turning points in Turkey. It is expected that the results to be obtained will enable us to identify and relate the contractions and expansions experienced in different periods in Turkey. In this way, it will be possible to establish a clear chronology of the different phases of business cycles and reveal the asymmetry among them. Moreover, it will be possible to evaluate the determined cycles as strong and weak depending on their structure.

In addition to this introduction as the first section, in the second part of the study, the empirical literature examining the characteristics of business cycles in the context of regime-switching models and the limited number of research results for Turkey are discussed. While the third section aims to reveal the conceptual framework and estimation method on which the model is based, the fourth section includes the data used in the estimation of the model, its properties, and the transformations required for its use in the model. Section five deals with the results from different forecasting models and the dating of business cycles. Finally, the sixth section highlights the results of the study.

2. Literature Review

Analyzing business cycles and determining their characteristics has been one of the important research areas of the empirical macroeconomics literature, and many studies are using different techniques for this purpose. The economic cycle definition made by Burns & Mitchel (1946) refers to a series of fluctuations consisting of expansion and contraction phases of production activities. “The average duration of these fluctuations in the context of the period between the two expansion periods ranges from 1.5 to 8 years. If these fluctuations are experienced in many sectors, they form the economic (common) cycle, if they are specific to sectoral production activity, they form the idiosyncratic cycle (Siklar & Siklar, 2021)”.

As stated by Siklar & Siklar (2021), "cycles (either economic or idiosyncratic) and trend are the unobservable components of the production series. In the literature, different techniques have been developed to estimate and quantify these components. The first of these techniques is the one proposed by Burns & Mitchel (1946) to measure production cycles in England, Germany, and the USA. Although this study has been widely criticized due to the subjective criteria it uses in determining the trend changes in the related series, its results are in line with the results obtained by the new and more complex methods used recently for production and investment data in the USA".

The important point in the economic cycle analysis is to be able to precisely determine the characteristics of the cycles in terms of duration, persistence, and asymmetry at different phases, and to identify the turning points that define the start and end of a cycle. Estimating an ARIMA model for the USA and measuring the length of business cycles, the study of Beveridge & Nelson (1981) on this subject is a pioneer in the empirical literature. Their measurements are in parallel with the start and end dates of the cycles determined by the National Bureau of Economic Research (NBER) in the USA and accepted as official evaluations. The importance of the study is due to the fact that it allows explaining the start and end dates of the cycles before NBER. Other studies using a similar technique and prominent in the literature include Nelson & Plosser (1982) and Campbell & Mankiw (1987). It is worth noting the studies of Harvey (1985) and Clark (1987), which attempted to measure US business cycles on the basis of unobservable components using the GNP data via the Kalman filter. On the other hand, Watson (1986) examines the characteristics of business cycles through the same method by adding variables such as disposable income and consumption expenditures. The common feature of the methods used in these studies is that they treat GDP or GNP growth rates as a linear stationary process. However, most macroeconomic and financial time series deviate from linearity and business cycles are naturally no exception. As a matter of fact, according to the common assessment in the literature, recessions are severe but short-lived, while expansions are long-lasting but gradual. The variances of these processes also differentiate among cycle phases (Siklar & Siklar, 2021).

The asymmetrical structure that characterizes the business cycle has been studied in great depth, later, in works such as Neftci (1984), DeLong & Summers (1986), Stock (1987), Diebold & Rudebusch (1990), Sichel (1989, 1993) and Artis et al. (1997). These studies provide empirical evidence about the asymmetric structure of business cycles, and they agree that static or dynamic linear models are insufficient to determine the asymmetry in the structure of the economic cycle concerning contraction and expansion periods.

Hamilton (1989) was the first researcher to propose the nonlinear model, now known as the regime change or Markov-Switching (MS) model. In this study, the regime change model is used to identify and measure economic recessions, thus making it possible to date economic cycles. The discrete changes of the mean between the two regimes and, therefore, the nonlinearity are included in the model through the estimated AR(4) process for the US GNP data. Thus, contractions and expansions are handled with their own dynamics, and for this purpose, a first-degree Markov process is created. In this sense, economic cycles differ as contraction and expansion cycles, and the developed model classifies each observation as one of these two regimes. The probabilities regarding which of these two regimes the observation is suitable for are calculated and used as classification criteria. In this way, it becomes possible to determine the duration and permanence of the cycle. The main advantage of this estimation process is that it does not require additional information of any kind other than the variable used.

In later periods, some researchers estimated different MS models by including features that express different aspects of business cycles in the model developed by Hamilton (1989). For example, Goodwin (1993) estimates the MS model to analyze business cycles based on data from 8 developed economies and determines the turning points of business cycles, and evaluates the symmetry between them. The work by Boldin (1996) extends the original model by adding a state.

In addition to the studies mentioned above, it is also necessary to mention the studies that deal with the state-space models and the MS model together, thus creating a hybrid model. Chauvet (1998), for instance, estimates an MS model with dynamic factors to evaluate the common behavior among different macroeconomic variables and to determine the asymmetry between the expansion and contraction phases of the business cycles. Similarly, French (2005) estimates an MS model with unobservable components to model the changes in the multi-factor productivity trend and evaluate the asymmetrical nature of its behavior at different stages of the business cycles.

Studies by Kontolemis (1999) and Moolman (2004) propose a different model, taking into account the evidence presented by Kahler & Marnet (1992) and Hamilton (1993) that variance varies between different stages of economic cycles. In this approach, the changes in the mean and variance between the two regimes are modeled together. Such models are now called *Markov-Switching with Heteroscedastic Variance* (MSH) models.

Another recent development in MS models is the use of classification models. In these models, the growth dynamics of the country are examined depending on a series of different state groups experienced over time. So, each defined state is characterized by its own sub-model and growth pattern. For example, Pritchett (2000) defines six growth periods to analyze the economic growth dynamics of 113 countries in total, and each state is associated with a certain growth level. Studies using similar methods include Jerzmanowski (2006), Kerekes (2012), and Morier & Kühl (2016) among others.

In the context of Turkey, many studies evaluate economic fluctuations from different perspectives[1]. While the majority of these studies focus on linear models, the number of studies using nonlinear models is limited. To ensure that the results to be obtained in our study are comparable, only the findings of those who used MS regime change models will be evaluated in this section. For example, Acikgoz (2008) estimates a two-state MS model using GDP and industrial production data and the results strongly support the shift in the mean for both types of data used. The obtained probability results show that there is a switching

[1] For a detailed literature review on Turkey, see Siklar & Siklar (2021).

between regimes in the growth process in the context of GDP. Similarly, Tastan & Yildirim (2008) use the two-regime MS model to analyze the characteristics of business cycles in the Turkish economy and date the expansion-contraction periods. In the study, which concluded that the phases of business cycles are asymmetrical, it is determined that the probability of transition from recession to expansion is higher than the probability of transition from expansion to recession. Kocaaslan (2016) in her study examining non-linearity and non-stationarity in production series in Turkey uses the MS model and concludes that the production series are not stationary during economic recession periods. Depending on these findings, it is concluded that shocks in production volume are quite permanent in recession periods and temporary in expansion periods. However, Bari & Siklar (2018), by using quarterly GDP data for the 2002-2016 period and employing the MS model, find that the expansions are permanent and the contractions are temporary. They also calculate that the expansion and contraction periods last approximately 2 years and 3.5 months, respectively. Terzioglu (2018), estimating a similar model for a longer sample (1986 – 2017) and using monthly industrial production data, makes comparisons with OECD-based business cycle dates. In this study, it is determined that the expansions take about 4.7 years, and the contractions last approximately 1.6 years. In a study with a similar purpose, Soybilgen (2020) uses monthly industrial production data to compare business cycle dating obtained through the MS model with the dating obtained through the BBQ (Bry and Boschan Quarterly) technique and concludes that the obtained turning points are largely matched.

Considering the above-outlined studies specific to Turkey, in which the MS methodology is used, it is seen that the change in the economic policy conception that has taken place especially since 2017 is not covered. However, this change in understanding has indisputably affected the economic cycles in Turkey and it still does. When the Covid-19 pandemic in the last two years is added to this change in understanding, the existence of up-to-date research is necessary to make correct assessments. The current study aims to determine the business cycle asymmetries, the persistency of the cycle stages, and their turning points in Turkey for the 1987-2021 period. To that end, we will employ approaches proposed by Hamilton (1989) and Kontolemis (1999) in the application of non-linear regime change models.

3. Model

According to Hamilton (1989), y_t as a stationary variable with an autoregressive process AR(k) can be represented as follows:

$$y_t - \vartheta_t^S = \alpha_1\left(y_{t-1} - \vartheta_{t-1}^S\right) + \alpha_2\left(y_{t-2} - \vartheta_{t-2}^S\right) + \ldots + \alpha_k\left(y_{t-k} - \vartheta_{t-k}^S\right) + \varepsilon_t \quad (1)$$

where the roots of the term $\alpha(L) = \left(1 - \alpha_1 L - \alpha_2 L^2 \ldots - \alpha_k L^k\right) = 0$ lie outside the unit circle provided that L represents the lag operator. Traditionally, the $\varepsilon_t \sim iid\, N(0,1)$ condition holds.

The changes in the conditional mean of this process (ϑ_t^S) and unobserved random state variable (Λ_t) constitute the source of the nonlinearity in the model. It is assumed that the state variable takes only discrete values and has its own dynamics. In this case, the conditional mean of the process can be defined as:

$$\vartheta_t^S = \vartheta_0 (1 - \Lambda_t) + \vartheta_1 (\Lambda_t) \tag{2}$$

According to the method proposed by Hamilton (1989) for dating business cycles, the unobservable variable will take discrete values varying between two states or regimes, that is, $\Lambda_t = \{1, 0\}$ and will be defined as:

$$\Lambda_t = \begin{cases} 0 \text{ if there is a contraction in } t \\ 1 \text{ if there is an expansion in } t \end{cases}$$

If the dates of regime changes were known a priori, the model proposed above would not differ from an autoregressive model with an instrumental variable in which Λ_t is the dummy variable. However, as stated before, state variable Λ_t is an unobservable one and has its own dynamics that are determined by its past values (such as $\Lambda_{t-1}, \Lambda_{t-2}, \ldots, \Lambda_{t-r}$). This means that we are dealing with an r-order Markov process with two states. According to Hamilton (1989), the probability of Λ_t being equal to a given regime will depend only on its final realization, namely Λ_{t-1}. In this case, for $i,j = 0,1$, we have

$$\Pr(\Lambda_t = j | \Lambda_{t-1} = i, \Lambda_{t-2} = h, \ldots) = \Pr(\Lambda_t = j | \Lambda_{t-1} = i) = p_0 \tag{3}$$

This process is known as a first-order ergodic Markov chain with two states. In the current model, the transition probabilities indicated by p_{ij} represent the probability of the economy changing from the i regime in the t-1 period to the j regime in the t period. Since $p_{01} = 1\text{-}p$ and $p_{01} = 1\text{-}q$, the transition probabilities as a whole will be defined by $p_{11} = p$ and $p_{00} = q$. In this case, p and q represent the persistence of a given regime over time and are determined by the expected duration of each regime $(1 - p_{ij})^{-1}$.

To estimate the first-order MS model, with two states and changes in the mean based on an AR(k) model, with the maximum likelihood method we need to obtain the density function of the variable we are studying, y_t. This function is obtained depending on the past information set (Ω_{t-1}) and the unobservable variable (S_t):

$$f(y_t | \Lambda_t, \Lambda_{t-1}, \Omega_{t-1})$$

For this, first of all, it is necessary to obtain the joint density function for y_t, Λ_t, and Λ_{t-1} based on the past information set (Ω_{t-1}):

$$f(y_t, \Lambda_t, \Lambda_{t-1} | \Omega_{t-1}) = f(y_t | \Lambda_t, \Lambda_{t-1}, \Omega_{t-1}) \Pr(\Lambda_t, \Lambda_{t-1} | \Omega_{t-1}) \tag{4}$$

Since Λ_t and Λ_{t-1} are discrete variables, by combining all their values, the marginal density function is obtained in the form of the following sums:

$$\begin{aligned} f\left(y_t|\Omega_{t-1}\right) &= \sum_{\Lambda_t=0}^{1}\sum_{\Lambda_{t-1}=0}^{1} f\left(y_t,\Lambda_t,\Lambda_{t-1}|\Omega_{t-1}\right) \\ f\left(y_t|\Omega_{t-1}\right) &= \sum_{\Lambda_t=0}^{1}\sum_{\Lambda_{t-1}=0}^{1} f\left(y_t|\Lambda_t,\Lambda_{t-1},\Omega_{t-1}\right)\Pr\left(\Lambda_t,\Lambda_{t-1}|\Omega_{t-1}\right) \end{aligned} \tag{5}$$

If we represent the number of regimes in the model with *R*, the marginal density is equal to the weighted average of R^2 conditional densities. The weights are defined for all *i* and $j = 0,1$ as follows:

$$\Pr\left(\Lambda_t = j,\Lambda_{t-1} = i|\Omega_{t-1}\right)$$

In this case, the logarithmic likelihood function to be maximized is

$$\ln\left(\mathrm{L}\right) = \sum_{t=1}^{T}\ln\left[\sum_{\Lambda_t=0}^{1}\sum_{\Lambda_{t-1}=0}^{1} f\left(y_t|\Lambda_t,\Lambda_{t-1},\Omega_{t-1}\right)\Pr\left(\Lambda_t,\Lambda_{t-1}|\Omega_{t-1}\right)\right] \tag{6}$$

On the other hand, to calculate the probability $\Pr\left(\Lambda_t = j,\Lambda_{t-1} = i|\Omega_{t-1}\right)$, the algorithm known as the Hamilton filter should be followed. This algorithm will be implemented by following the steps suggested by Kim & Nelson (2017): In the first step, while probability values $\left[\Pr\left(\Lambda_{t-1} = i|\Omega_{t-1}\right)\right]$ are given for all *i* at the beginning of period *t*, the weights for all *i* and *j* are calculated as:

$$\Pr\left(\Lambda_t = j,\Lambda_{t-1} = i|\Omega_{t-1}\right) = \Pr\left(\Lambda_t = j|\Lambda_{t-1} = i,\Omega_{t-1}\right)\times\Pr\left(\Lambda_{t-1} = i|\Omega_{t-1}\right) \tag{7}$$

Here the probabilities $\left[\Pr\left(\Lambda_t = j,\Lambda_{t-1} = i|\Omega_{t-1}\right)\right]$ for all *i* and *j* are equal to the transition probabilities defined earlier. In the second step, when y_t is observed at the end of period *t*, the probabilities are updated as follows:

$$\begin{aligned} \Pr\left(\Lambda_t = j,\Lambda_{t-1} = i|\Omega_t\right) &= \Pr\left(\Lambda_t = j,\Lambda_{t-1} = i|\Omega_{t-1},y_t\right) \\ &= \frac{f\left(\Lambda_t = j,\Lambda_{t-1} = i,y_t|\Omega_{t-1}\right)}{f\left(y_t|\Omega_{t-1}\right)} \\ &= \frac{f\left(y_t|\Lambda_t = j,\Lambda_{t-1} = i,\Omega_{t-1}\right)\times\Pr\left(\Lambda_t = j,\Lambda_{t-1} = i,\Omega_{t-1}\right)}{f\left(y_t|\Omega_{t-1}\right)} \end{aligned} \tag{8}$$

Notice that the denominator of the last equation corresponds to the equation (5) and the probabilities are obtained as:

$$\Pr\left(\Lambda_t = j \middle| \Omega_t\right) = \sum_{S_{t-1}=0}^{1} \Pr\left(\Lambda_t = j, \Lambda_{t-1} = i \middle| \Omega_t\right) \tag{9}$$

These two steps expressing the Hamilton filter are repeated for all $t = 1,2,\ldots, T$ to obtain appropriate weights. The operation of the filter for two different regimes requires the following initial conditions:

$$\begin{aligned} \beta_0 &= \Pr\left(\Lambda_0 = 0 \middle| \Omega_0\right) = \frac{1-p}{2-p-q} \\ \beta_1 &= \Pr\left(\Lambda_0 = 1 \middle| \Omega_0\right) = \frac{1-q}{2-p-q} \end{aligned} \tag{10}$$

Considering the explanations above, to make an inference from the MSM(2) – AR(k) model, it is sufficient to estimate the model parameters (ϑ_0, ϑ_1, σ^2, p, and q) that maximize the logarithmic likelihood function. Using these estimated parameters, it is possible to make inferences for the unobserved variable Λ_t for all $t = 1,2, \ldots, T$. For this purpose, filtered probabilities $\left[\Pr\left(\Lambda_t = 0 \middle| y_t, y_{t-1}, \ldots, y_1\right)\right]$ and smoothed probabilities $\left[\Pr\left(\Lambda_t = 0 \middle| y_T, y_{T-1}, \ldots, y_1\right)\right]$ regarding which of the two regimes Λ_t belongs to are obtained.

This model can be enhanced by making use of Moolman (2004) considering that the variance of ε_t may also depend on the regime change. The new model to be developed will also include the autoregressive process detailed in equation (1), but in this case, the $\varepsilon_t \sim N\left(0, \sigma^2_{S_t}\right)$ condition will be valid for the residual terms. The conditional mean of this process will be obtained as in equation (2) and its variance will be defined as follows:

$$\sigma^2_{\Lambda_t} = \sigma^2_0\left(1-\Lambda_t\right) + \sigma^2_1 \Lambda_t$$

In this new model, the unobservable variable will take the same discrete values (ie $\Lambda_t = \{1, 0\}$) and the Markov dynamics will take place as defined in equation (3). This model (which we will briefly call MSH(2) – AR(k) in the paper's following sections) is a two-state first-order MS model with changes in mean and heteroscedastic variance, and it follows the maximum likelihood estimation procedure outlined above. The only difference in this process is that the parameters to be estimated are ϑ_0, ϑ_1, σ^2_0, σ^2_1, p and q.

For both models developed above, it is possible to define the turning points of the series studied based on the following criteria: If the probability calculated for a certain date (λ) is $\Pr\left(\Lambda_t = 0 \middle| y_T, y_{T-1}, \ldots, y_1\right) < 0.5$ and $\Pr\left(\Lambda_{t+1} = 0 \middle| y_T, y_{T-1}, \ldots, y_1\right) > 0.5$, this date will be determined as the peak of the cycle. If the probability is calculated as

$\Pr\left(\Lambda_t = 0 \middle| y_T, y_{T-1}, \ldots, y_1\right) > 0.5$ and $\Pr\left(\Lambda_{t+1} = 0 \middle| y_T, y_{T-1}, \ldots, y_1\right) < 0.5$, the λ point will be accepted as a trough point of the cycle.

4. Data

The variable used to analyze the economic cycles is the real GDP series published by the Turkish Statistical Institute (TURKSTAT). This series has a quarterly frequency and includes data for the period 1987:1 – 2021:4, measured at 2009 prices. Since Hamilton (1989) suggested that the relevant time series be seasonally adjusted, the data obtained from the TURKSAT are seasonally adjusted by the TRAMO-SEATS method (see Figure 1) and then transformed to logarithmic form.

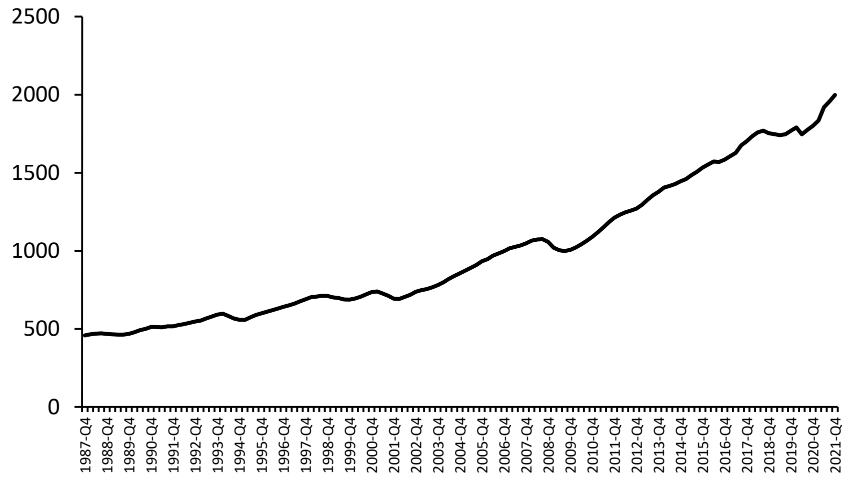

Figure 1. Seasonally Adjusted Real GDP (in 2009 Prices)

The log of the seasonally adjusted real GDP variable (y_t) was subjected to various unit root tests. All tests and their versions, the results of which are summarized in Table 1, show that the series is not stationary at the logarithmic level but is the first difference stationary. Therefore, the series to be used in this study is the first difference of the logarithmic seasonally adjusted real GDP, in other words, the economic growth rate expressed as a percentage. The course of this time series during the analyzing period is shown in Figure 2.

Table 1. Unit Root Test Results

Tests	*y*			*Δy*		
	Lag[1]	Test Statistic	Prob.[2]	Lag[1]	Test Statistic	Prob.[2]
Augmented Dickey-Fuller (ADF)						
Trend + Intercept	5	2.6791	0.2471	4	4.2210	0.0055
Intercept	5	0.2035	0.9789	4	4.2046	0.0010
None	5	3.4801	0.9999	4	2,2833	0.0222
Phillips-Peron (PP)						
Trend + Intercept	3[3]	2.4009	0.3775	9[3]	4.0578	0.0091
Intercept	3	0.6024	0.9894	9	4.0582	0.0016
None	3	6.0598	1.0000	7	3.9452	0.0001
Break-Point Dickey-Fuller						
Trend + Intercept	5	4.1601	0.2805	0	5.2413	0.0156
Intercept	5	1.6661	0.9932	0	5.2501	0.0000

(1) Lag selection is based on Schwarz Information Criterion, (2) Prob. refers to marginal significance level, (3) For PP Tests, it indicates the band width.

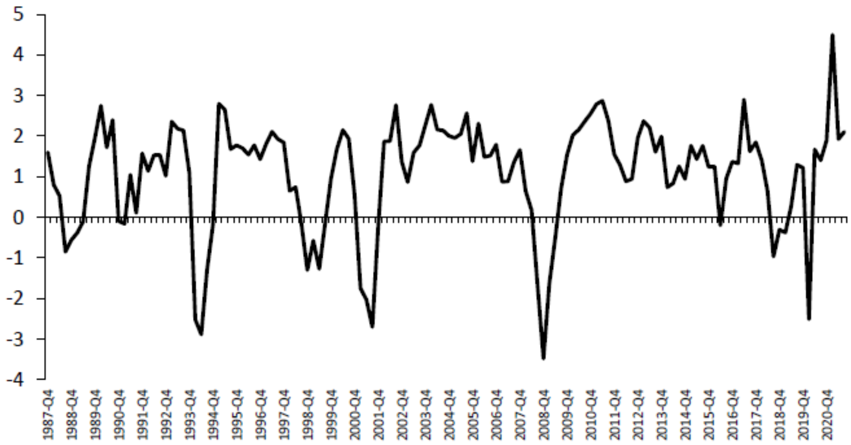

Figure 2. Growth Rate of Seasonally Adjusted Real GDP

5. Estimation Results

MSM(2)-AR(k) and MSH(2)-AR(k) models, which are detailed in the third part of the study, are estimated for Turkey using the 1987:1 – 2021:4 quarterly data. Unlike Hamilton (1989), the degree of the autoregressive process was determined within the framework of the method proposed by Chauvet (1998). According to this method, the degree of k that minimizes the Schwarz Information Criterion among various univariate linear models is determined as the degree of the autoregressive process to be used in the MS model. Depending on this criterion, the most suitable model was determined as AR(1). The results obtained by estimating the MSM(2)-AR(1) and MSH(2)-AR(1) models are given in Table 2. Although it covers a shorter period (2002 - 2016), the results obtained by Bari & Siklar (2018) are also included in the same table, since it is the only study that can be compared with the results of the current study.

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Table 2. Estimation Results

Parameter	MSM(2)-AR(1)	MSH(2)-AR(1)	Bari-Siklar (2018) MSM(2)-AR(4)
ϑ_0	-1.8324 (0.4113)	-2.7566 (0.9661)	-2.4676 (0.6375)
ϑ_1	2.1161 (0.2931)	2.8959 (0.7129)	1.8407 (0.1994)
α_1	-0.2198 (0.0649)	-0.3009 (0.0987)	-0.1209 (0.2246)
α_2	--	--	-0.3935 (0.2039)
α_3	--	--	0.0617 (0.1650)
α_4	--	--	0.0950 (0.2541)
σ_0^2	0.3223 (0.0801)	0.3873 (0.1922)	0.2925 (0.1238)
σ_1^2	--	0.3079 (0.1921)	--
p_{00}	0.3218 (0.0499)	0.2927 (0.0674)	0.1158
p_{11}	0.6783 (0.2446)	0.7071 (0.2233)	0.8841
D_0	4.08	3.25	1.13
D_1	9.88	8.12	8.63
MSE	0.1946	0.2461	--
Theil	0.1261	0.1979	--

Notes: D_0 and D_1 show the average duration of contractions and expansions, respectively. MSE refers to mean square error while Theil is the Theil's inequality coefficient. Numbers in parentheses indicate the standard errors.

The MSM(2) – AR(1) model, defined by equations (1), (2), and (3), was estimated by the maximum likelihood method explained in the third section. The results in the first column of Table 2 are economically consistent and statistically significant. According to the results obtained for this model, the average economic growth rate is -1.18 in recession periods and 2.11 in recovery periods. Recession periods are not as permanent as expansion periods and their probabilities reach 0.32 and 0.67, respectively. According to these probability values, the average duration of recessions is 4.08 quarters and the average duration of expansions is 9.88 quarters. The economic growth rates realized and estimated through the MSM(2)-AR(1) model are given in Figure 3. In the next step, the smoothed probabilities of being in recession for each observation are calculated and given in Figure 4.

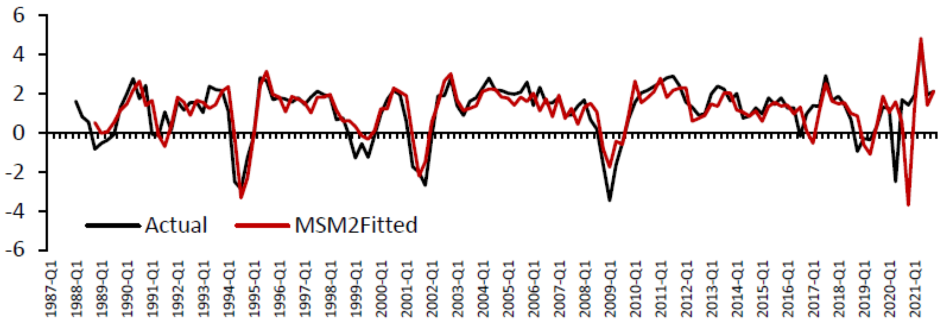

Figure 3. Actual and Estimated GDP Growth Rates with MSM(2)-AR(1) Model

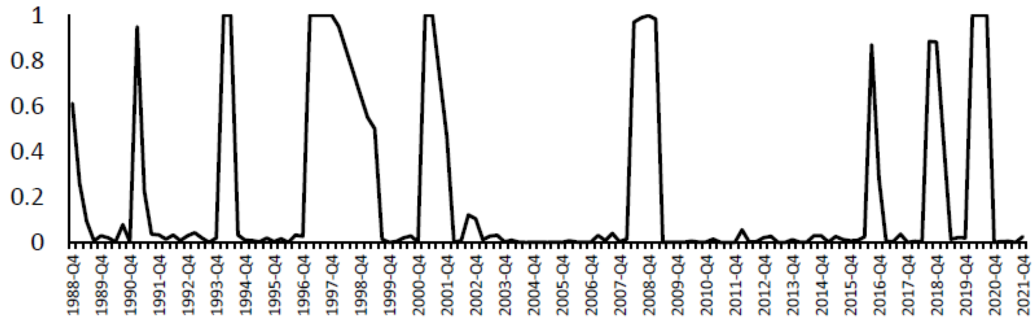

Figure 4. Smoothed Recession Probabilities for MSM(2)-AR(1) Model

The MSH(2) – AR(1) model, defined by equations (1), (2), and (9), was estimated by the maximum likelihood method as in the previous model, and the results are summarized in the second column of Table 2. The results obtained are economically consistent and statistically significant. The results obtained for this alternative model differ slightly from the results obtained from the MSM(2) – AR(1) model. According to the results obtained for the alternative model, Turkey's average economic growth rate is -2.76 percent in recession periods and 2.90 percent in expansion periods. Regarding the persistence of the regimes, the probability of being in recession and remaining in it reaches 29%, while in the case of being in expansion, said probability is 71%. These probability values can be considered close to the previous method. The average duration of recessions was 3.25 quarters, and the average duration of recovery periods was approximately 8.12 quarters. The average durations obtained for both regimes are lower than the first model. The accuracy of the results produced by the model and the smoothed probabilities of being in a recession are given in Figures 5 and 6, respectively.

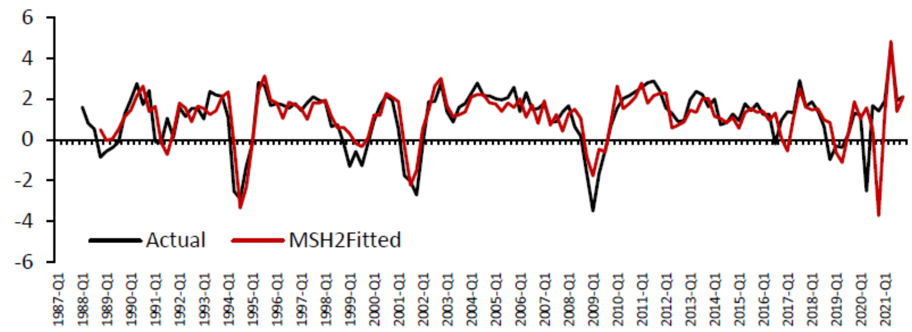

Figure 5. Actual and Estimated GDP Growth Rates with MSH(2)-AR(1) Model

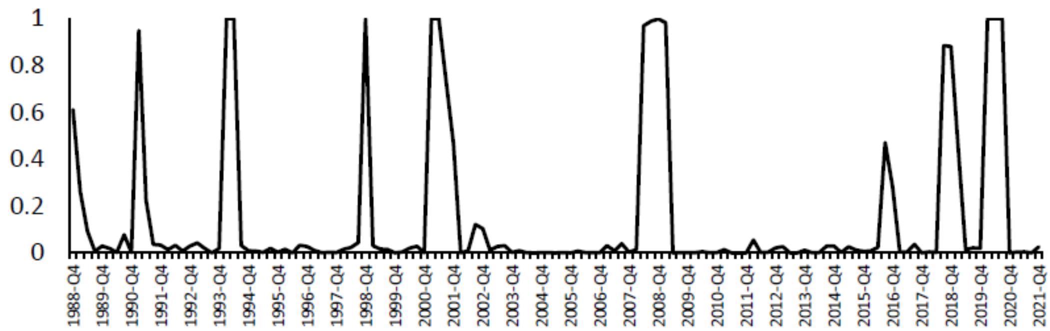

Figure 6. Smoothed Recession Probabilities for MSH(2)-AR(1) Model

Considering the results obtained from both models, it is possible to evaluate the asymmetric structure of business cycles in Turkey: The recovery periods last about 8.5 quarters and are long and permanent. On the other hand, contraction periods are short, variable, and temporary, lasting around 4 quarters on average. The results obtained from the models estimated in this study differ clearly from the results of Bari & Siklar (2018). These differences are observed in the average economic growth rates in recession and recovery periods, in the probabilities of recession and recovery periods, and in the average duration of these periods. Although the variable used to evaluate the business cycle fluctuations is the same, the differences in the results are due to the different analyzing periods. While Bari & Siklar (2018) considers a relatively short sample covering the period 2002-2016, the current study investigates a longer period covering the years between 1987 and 2021. While the 1987-2001 period in Turkey was a period of intense political and economic instability, the 2002-2016 period was a period in which political stability left its mark on the economy. Social unrest in the 1987-2001 period, when coalition governments changed frequently, also accompanied economic instability. The 1992-1993 European Exchange Rate Mechanism Crisis, 1994 Mexican Crisis, 1997 Asian Crisis, 1998 Russian Crisis, and 2001 Argentine Crisis, which were experienced during the mentioned period, also deeply affected the Turkish economy. Faced with serious short-term capital outflows and speculative attacks during these periods, the economy had to devalue the domestic currency in 1994 and 2001 as a result of balance of payments problems. During these periods, the Turkish economy experienced the most severe and longest economic depression periods in its history, and high inflation accompanied this process. On the other hand, although the duration of the recessions experienced in the period following the 2008 global crisis has decreased, the average time from one trough to the other has shortened. In this case, it is natural that the results obtained differ.

Based on the method proposed by Goodwin (1993), the performances of the two models estimated in this study were evaluated based on mean square error and Theil inequality coefficient. According to the results given in the relevant lines of Table 2, it is concluded that the MSM(2) – AR(1) model produces more accurate results in the context of both criteria. For this reason, it is more correct to use the probability values obtained from this model in dating the turning points of the business cycles. However, the smoothed probabilities obtained from the models estimated in this study were used within the framework of the criteria explained in the third section, and the turning points were determined separately for the 1987-2021 period. Table 3 shows the results of this dating process. On the other hand, Figures 7 and 8 arrange these dates separately for both models to compare them with the actual growth rates.

Table 3. Chronology of Business Cycles in Turkey Based on Markov Switching Models

Turning Point	MSM(2)-AR(1)	MSH(2)-AR(1)	Turning Point	MSM(2)-AR(1)	MSH(2)-AR(1)
Peak	1988:Q1	1988:Q1	*Peak*	2008:Q1	2008:Q1
Trough	1988:Q4	1988:Q4	*Trough*	2009:Q1	2009:Q1
Peak	1990:Q2	1990:Q2	*Peak*	2015:Q4	
Trough	1991:Q2	1991:Q2	*Trough*	2016:Q3	
Peak	1993:Q3	1993:Q4	*Peak*	2017:Q3	2017:Q3
Trough	1994:Q3	1994:Q3	*Trough*	2018:Q4	2018:Q4
Peak	1997:Q4	1998:Q1	*Peak*	2020:Q1	2019:Q4
Trough	1999:Q3	1998:Q4	*Trough*	2020:Q3	2020:Q3
Peak	2000:Q4	2000:Q3			
Trough	2001:Q4	2001:Q3			

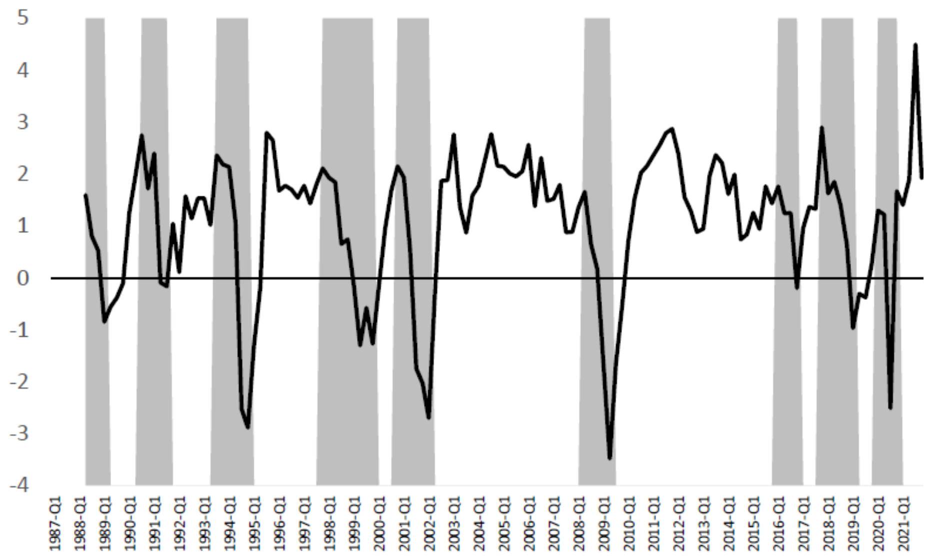

Figure 7. Real GDP Growth Rate and Identified Recessions through MSM(2)-AR(1) Model

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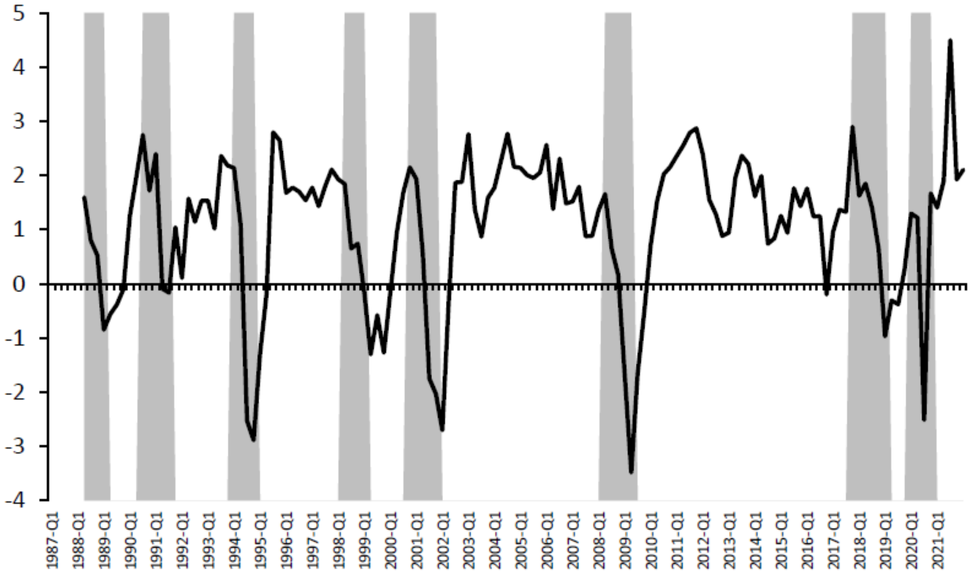

Figure 8. Real GDP Growth Rate and Identified Recessions through MSH(2)-AR(1) Model

As can be seen from the related tables and graphs, both MS models mostly produce the same turning points. However, the MSM(2)-AR(1) model yields more turning points than the alternative model. On the other hand, the periods of economic recession and expansion determined by this model are of longer duration. When the determined cycle points are examined closely, it is understood that the economy was constantly struggling with crises between the years 1987 and 2001. The possible reasons for this situation, as mentioned already, are the contagion of the international crises on the country, the frequent balance of payments problems due to the exchange rate policy, high inflation, and political instability. It is worth noting that, if the recession experienced with the 2008 global economic crisis is excluded, the Turkish economy has lived through a long expansion period between 2002-2016 according to the MSM(2)-AR(1) model. MSH(2)-AR(1) model, however, expands this duration to the 2002-2018 period. The post-2002 period was the period in which the monetary policy towards inflation targeting was applied consistently with the flexible exchange rate regime. This period, in which the inflation rate was reduced up to 6% as a result of highly credible monetary and fiscal policies together with political stability, seems to have ceased as a result of the transition to the presidential regime in 2018 and the subsequent interventions to monetary policy.

6. Conclusion

Analyzing business cycles includes determining the duration of economic fluctuations, their turning points, their persistence, and the asymmetry between different phases. The present study analyzes macroeconomic cycles in Turkey by identifying these characteristics. For this purpose, the nonlinear regime change model known as the Markov Switching, which has been used extensively in empirical research in macroeconomics in recent years, has been employed.

General characteristics of business cycles in Turkey were obtained by using the information obtained from the seasonally adjusted quarterly real GDP data covering the period 1987 – 2021 and estimating different variations of the Markov Switching model. According to the results obtained, the asymmetry between the different stages of business cycles is characterized by short-term periods of temporary recession and long-term periods of permanent recovery.

The compatibility of the obtained results with the national and international developments experienced during the analyzing period indicates the consistency of the developed models. The results also reveal the importance of consistent and credible monetary and fiscal policies in smoothing business cycles.

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