(REFEREED RESEARCH)

ANALYZING THE NONLINEAR DYNAMICS OF THE TURKISH TEXTILE AND APPAREL INDUSTRIES

TÜRK TEKSTİL VE KONFEKSİYON SANAYİLERİNİN DOĞRUSAL OLMAYAN DİNAMİKLERİNİN ANALİZİ

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ABSTRACT

Developments in the Turkish textile and apparel industries carry a high influence on the development of Turkish economy with their substantial shares in the total industrial production. This is the first study that documents the cyclical economic asymmetric behavioral dynamics of the Turkish textile and apparel industries by utilizing the Markov regime switching models to the mean and variance at monthly frequencies by using Expectation Maximization algorithm. The results provide a further detailed insight about the asymmetric dynamics of these sectors by examining nonlinearity, determining the number of regimes, identifying the regime dependent variances, calculating the transition and smoothed probabilities, and documenting the regime classifications with respect to each identified regime. The study also employs the estimated transition probabilities to define and quantify the duration and persistence of staying in each particular regime for each of the sectors. Revealing these results about the Turkish textile and apparel industries gives a better understanding for policy makers in terms of designing effective policies to increase competitiveness in the global markets.

Keywords: Textile and Apparel Industries, Turkish Economy, Markov Switching Models, Time Series Analysis

ÖZET

Türk tekstil ve konfeksiyon sanayilerindeki gelişmeler, toplam imalat sanayi üretiminde büyük paylara sahip olmaları nedeniyle Türkiye ekonomisi üzerinde oldukça önemli bir etkiye sahiptir. Bu çalışma, Türk tekstil ve konfeksiyon sektörlerinin döngüsel asimetrik dinamiklarini incelemek üzere beklenti maksimizasyonu algoritması ile ortalama ve varyanstaki değişimlere izin veren Markov rejim değişim modelini kullarak sektörlerin döngüsel hareketlerini aylık frekansta modelleyen ilk çalışmadır. Elde edilen sonuçlar bu sektörlerin asimetrik dinamikleri hakkında detaylı bilgilere sahip olmamızı sağlamaktadır. Çalışmada tekstil ve konfeksiyon sanayileri için en uygun ekonomik modellerin doğrusal olmayan modeller aracılığıyla elde edilebileceği ve incelenebileceği ortaya konulmuş, her bir sektör için optimum rejim sayıları belirlenmiş, farklı rejim durumuna göre hem değişen ortalamalar hem de değişen varyans değerleri tanımlanmış ve her bir rejim için geçiş olasılıkları hesaplanmıştır. Ayrıca, bu sektörlere ait döngüsel hareketler için belirlenen rejimlerin süreleri tespit edilmiş ve sektörlerin aynı karakteristik rejimde kalmaları konusunda ne kadar istikrarlı olduklarını anlamak için geçiş olasılıkları tahmin değerleri hesaplanılmış ve kullanılmıştır. Çalışmadan elde edilen sonuçlar global piyasalarda rekabet gücünü artırmak üzere etkin politikalar tasarlanması açısından Türk tekstil ve konfeksiyon sektör dinamiklerinin değişken yapısına dair politika yapıcılara daha detaylı ve anlaşılır bilgiler sunmaktadır.

Anahtar Kelimeler: Tekstil ve Konfeksiyon Sanayii, Türkiye ekonomisi, Markov değişim modelleri, Zaman Serileri Analizi

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1. INTRODUCTION

Textile and apparel industries are among the most important components of the Turkish manufacturing industry. These sectors have played a remarkable role for the industrialization process of the Turkish economy. The production share of these key sectors has shifted from developed economies to the developing ones in recent years. Therefore, developing economies gain more importance for their production characteristics, while the developed ones mostly has the superiority in design and innovation over the global textile and apparel markets.

Textile and apparel sectors have a key role for the manufacturing industry considering their importance for structural transformation of the Turkish economy. The weights of these sectors in the Turkish manufacturing industry are quite high with the corresponding ratios of

8.92% and 6.59% and total proportion of 15.51%.[2] It is particularly important with their value added properties, contribution to employment and foreign trade. According to the last report of the World Trade Organization on the International Trade Statistics[3], Turkey has a remarkable position in the world textile and apparel exporters ranking, being the 5th largest supplier in the world textile trade and 7th largest supplier in the world apparel trade for the year of 2014. Therefore, developments in the textile and apparel sectors have a great influence on the manufacturing industry, and hence on the overall Turkish economy.

With the agreement of the World Trade Organization that was signed in 1995 and put into effect in 2005, the sectors of textile and apparel have become more competitive globally as it eliminates the quotas in the textile and apparel trade. Moreover, in 2001, Chinese's entry into the market as a competitor with being a part of this agreement brings a heavier pressure of competitiveness for the Turkish textile and apparel sectors. Understanding the asymmetric cyclical behavior of these sectors with respect to regime dependent dynamics gives a better understanding for policy makers to design effective policies in order to increase the robustness of competitiveness in the global market. To this end, structural transformations are required to realize sustainable development. By achieving required structural transformations, higher value added products can be produced in these sectors of the manufacturing industry and the production structure of these sectors will be able to provide innovation that is required for an accelerated economic development in Turkey. In this context, this study provides detailed information on understanding the asymmetric behaviour of these key sectors to create industrial policies that affect the overall economic structure for a stable development process.

The sectors of textile and apparel in Turkish economy are mostly studied on the grounds of the relationship between the industrialization structure and competitive capacity in the foreing trade. Taymaz [17]'s study examines the competitiveness of the Turkish textile and clothing industries and identifies its sources and changes in competitive conditions. The study concludes that textile and clothing industries in Turkey exhibit high competitive characteristics among the EU and the US markets. Moreover, Karaalp and Yilmaz [11], examines Turkey's comparative advantage and competitiveness of textile and clothing products in the EU market based on Balassa's revealed comparative advantage (RCA) index and Vollrath's competitiveness indices for the period of 1988 and 2008. The results show that Turkey has a strong comparative advantage and competitiveness in both textile and clothing in the whole EU market. When compared to these two sectors in particular for Turkey, Turkey's comparative advantage in the clothing industry is stronger than its comparative advantage in the textile industry. Kayali [12], calculates efficiency scores of the companies that performs in the Turkish textile industry in terms of profitability for the year of 2007 by using the data envelopment analysis methodology. The findings reveal a low efficiency score in the textile sector. Atılgan, Derafshi and Kanat [1] evaluate Iran's textile and clothing sectors between Turkey and Iran. The study, which employs SWOT analysis to survey the efficiency of the competitivenes factors, points out that textile and clothing sectors in Iran doesn't have a competitive situation with its current weak structure. Gacener [10] examines the level of competition of the Turkish textile industry by comparing the EU-27, the United States and the Middle East - North Africa for the time period of 1995-2012. The results show that Turkey's textile and clothing industries have importance on particular groups of product in the market, with gradually decreasing levels. Gencosmanoglu & Ertugrul [9] examine Turkey's import demand for cotton, which is an essential production input for textile and apparel industries, by utilizing Autoregressive Distributed Lag (ARDL) methodology and estimate the Armington elasticity for cotton demand. The results document that price policies on cotton may have important economic impacts on domestic production and trade in Turkey. The study of Öztürk & Girginer [15] evaluates the export efficiency of textile and apparel firms listed in the 2012 Istanbul Chamber of Industry (ICI) 500 report by using Data Envelopment Analysis (DEA) and Analytic Hierarchy Process (AHP) methods. The study utilizes the AHP method to identify the importance level of qualitative and quantitative factors for the export efficiency of efficient firms. The results obtained from the study show that apparel companies are more active compared to the textile companies.

On the other hand, studies that research economic fluctuations in the Turkish textile and apparel sectors are relatively limited. Recently, the study of Duran [6] analyzes the business cycles of textile and apparel industries in Turkey by employing Hodrick-Prescott (HP) filtering with Bry-Boschan algortihm on time series. The findings point out the volatile growth pattern of textile and apparel industries and their leading position for the economic fluctuations in Turkey that might be used as an early warning indicator. Baycan [2] examines the cylical asymmetric dynamics for the capacity utilization rates of the Turkish manufacturing industry, which includes the textile and apparel industries among of the other ones, by using nonlinear Markov switching methods. Nevertheless, the literature has no study the on textile and apparel industries for any of the developing countries that employs nonlinear Markov regime switching approach to characterize the cyclical asymmetric dynamics of these industries. This is the first study that documents the cyclical economic asymmetric behavioral dynamics of the Turkish textile and apparel industries to fulfil this gap by utilizing the regime switching type of nonlinear models.

In recent years, the global economy has experienced rapid and sudden changes in trade and capital flows that cause emerging market economies to be weaker in the global markets. These economies have been highly affected by the increasing global volatility. Tracking the regime dependent dynamics for regime dependent policies rather than implementing completely autonomous and stable ones can offer further policy options. In that point, nonlinear regime switching models gain considerable importance due to their ability of capturing the asymmetric behaviors across cyclical

[2] According to the official calculations of the Turkish Statistical Institute.

[3] See for further information ,WTO International Trade Statistics 2015 edition.

phases, considering the presence of abrupt shifts among different states of the economy. In this contex, the study employs regime switching Markov models to the mean and variance at monthly frequencies by using Expectation Maximization (EM) algorithms. Analyzing these type of models lets us to suggest policies with respect to different regimes in the economy.

2. THE MODEL AND DATA

Since the seminal work of Hamilton [7], a vast number of studies have been carried out on the examination of economic time series with nonlinear methods in order to date and classify business cycles. This study characterizes the cyclical asymmetric economic dynamics of the textile and apparel industries in Turkey based on Markov regime switching models for the first time in the related literature. Markov switching framework allows to model the periodic shifts[4] in the model parameters with respect to different phases of the concerned variables. Therefore, the models have ability to capture the cyclical regime dynamics that depends on the unobservable stochastic variable.

Let y_t stands for the Turkish textile and apparel industries that can be written as the sum of two components,

$$y_t = n_t + z_t$$

where the term of n_t refers the Markov trend and the term of z_t refers the Gaussian component.

The Markov trend is consists of,

$$n_t = \alpha(s_t) + n_{t-1}, \quad (2)$$

where $s_t \in \{1,\ldots,M\}$ is a latent Markov processes that determines the state of the economy and $\alpha(s_t) = \alpha_i$ for $s_t = i$, $i \in \{1,\ldots,M\}$.

It follows, then, the Markov regime switching dynamics formulate a probability rule for the transition between states. The unobserved state variable, s_t, follows a first-order Markov-process, where the current regime depends solely on the regime that prevails one period ago.

The rule of probability is given with,

$$P[s_t = j | s_{t-1} = i, s_{t-2} = k, \ldots] = P[s_t = j | s = i] = p_{ij}, \quad (3)$$

the probability that state i will be followed by state j is indicated by p_{ij} and $i, j, k \in \{1,\ldots,M\}$. By rules of probability, we have $\sum_{j=1}^{M} p_{ij} = 1$.

The second term in Equation (2), which is the Gaussian component, is given by:

$$z_t = z_{t-1} + \phi_1(z_{t-1} - z_{t-2}) + \cdots + \phi_r(z_{t-r} - z_{t-r-1}) + \varepsilon_t \quad (4)$$

where $\varepsilon_t / \sigma(s_t) \sim NID(0,1)$ and is independent of n_{t+h}, $h \geq 0$. By differencing Equation (1) and substituting (4) we obtain,

$$\Delta y_t = \alpha(s_t) + \phi_1(z_{t-1} - z_{t-2}) + \cdots + \phi_r(z_{t-r} - z_{t-r-1}) + \varepsilon_t \quad (5)$$

This model is able to identify regimes that are characterized by different regime parameters. Considering structural breaks in the textile and apparel industries due to the major policy changes in Turkish economy, the study uses a hidden Markov specification where the autoregressive terms in Equation (4) are set to zero[5].

The differenced series becomes,

$$\Delta y_t = \alpha(s_t) + \varepsilon_t \ . \quad (6)$$

Following Hamilton [8], we estimate the models using EM algorithm together with the nonlinear filter to find the maximum likelihood estimates of the model parameters. It is a convergence method that provides an optimizing for distributed parameters. Note that, we do not impose any a priori restrictions on model parameters and infer the states through statistical estimation. The EM algorithm is further described in Dempster, Laird and Rubin [5] and Krolzig [14].

The study employs seasonally adjusted monthly Turkish textile and apparel manufacturing industry production indices that covers the periods from January 2005 to September 2015. The data is obtained from the statistical database of the Turkish Statistical Institute. Following Stock and Watson [16], high frequency movements in the different series of Turkish textile and apparel manufacturing index are smoothed out by taking twelve-month differences of the annual month-to-month growth rates in logarithms.

3. EMPIRICAL RESULTS

We first examine the unit roots in the employed series using the Augmented Dickey-Fuller the Phillips Perron tests. Stationarity is obtained after taking twelve-month averages of the annual month-to-month growth rates of for the series of the Turkish textile and apparel industries. Then, we investigate the asymmetric characteristics of the Turkish textile and apparel industries and provide a detailed insight about their dynamics. We examine nonlinearity, determine the number of regimes, identify the regime dependent variances, find the transition and smoothed probabilities, and document regime classification with respect to each identified regime. The results are given in Table 1 for the selected models of these two industrial sector. Figure 1 and Figure 2 also show the smoothed probabilities for each different regime and the fitted values for the Turkish textile and apparel industry.

[4] See for further information, Kim & Nelson [13]

[5] See Chauvet [3] for an application on Brazilian economy.

Table 1. MSMH(3) – AR(0) Results for Monthly Turkish Textile and Apparel Industries

	Turkish Textile Industry	Turkish Apparel Industry
log-L	265.864677	-258.860769
LRP	0.0000	0.000
α_0	-6.18112 (0.9612)	-4.74718 (0.4983)
α_1	-0.478081 (0.4099)	-0.0864877 (0.2155)
α_2	2.61148 (0.3708)	3.99611 (0.4223)
σ_0	3.23645 (0.4939)	2.12584 (0.3300)
σ_1	1.05105 (0.2233)	1.27274 (0.1718)
σ_2	2.07005 (0.2479)	2.09245 (0.2703)
p_{00}	0.911312 0.05990	0.866180 (0.07135)
p_{01}	0.555087 (0.03994)	0.0440053 (0.03189)
p_{11}	0.841121 (0.1313)	0.882585 (0.05091)
p_{12}	0.0734264 (0.04786)	0.103630 (0.05849)
AIC	4.9924	3.9654
SC	4.8382	4.2251
HQ	4.7327	4.0709

Notes: The sample period is January 2005 - September 2015. LRP denotes the upper bound for the p-value of the likelihood ratio test of linearity based on Davies [4]. Standard errors are reported in parenthesis.

Table 1 shows the estimated parameters of regime dependent mean, variance and transition probabilities along with the AIC, HQ and SIC model selection criteria test results, Likelihood Ratio statistics, and the Davies upper bound p-values for the Turkish textile and apparel industries. Likelihood ratio statistics and information criteria tests are employed to identify the number of states and to examine regime switching heteroscedasticity to determine the changes in variance structure with reference to different regimes. According to the values of the Davies upper bound, linearity is rejected in favor of the nonlinear model. The strong asymmetry is reported by the upper bound values and by the various significant estimates and regime probabilities across different states. The information criteria and modified likelihood ratio tests provide the regime specifications of the selected models by comparing a 3 state versus a 2 state specification. The results and the values for identifying number of regimes that depend on state dependent dynamics suggest that a three-state specification fits better than a two state specification for the textile and apparel industries. A three state specification lets us to decompose the positive growth regime into moderate and high growth regimes for the fluctuations of the Turkish textile and apparel industries.

We examine the nonlinear dynamics for heteroskedasticity of the Turkish textile and apparel industries. Test results document the presence of regime dependent variances. The estimated variance values of the low growth regime for both

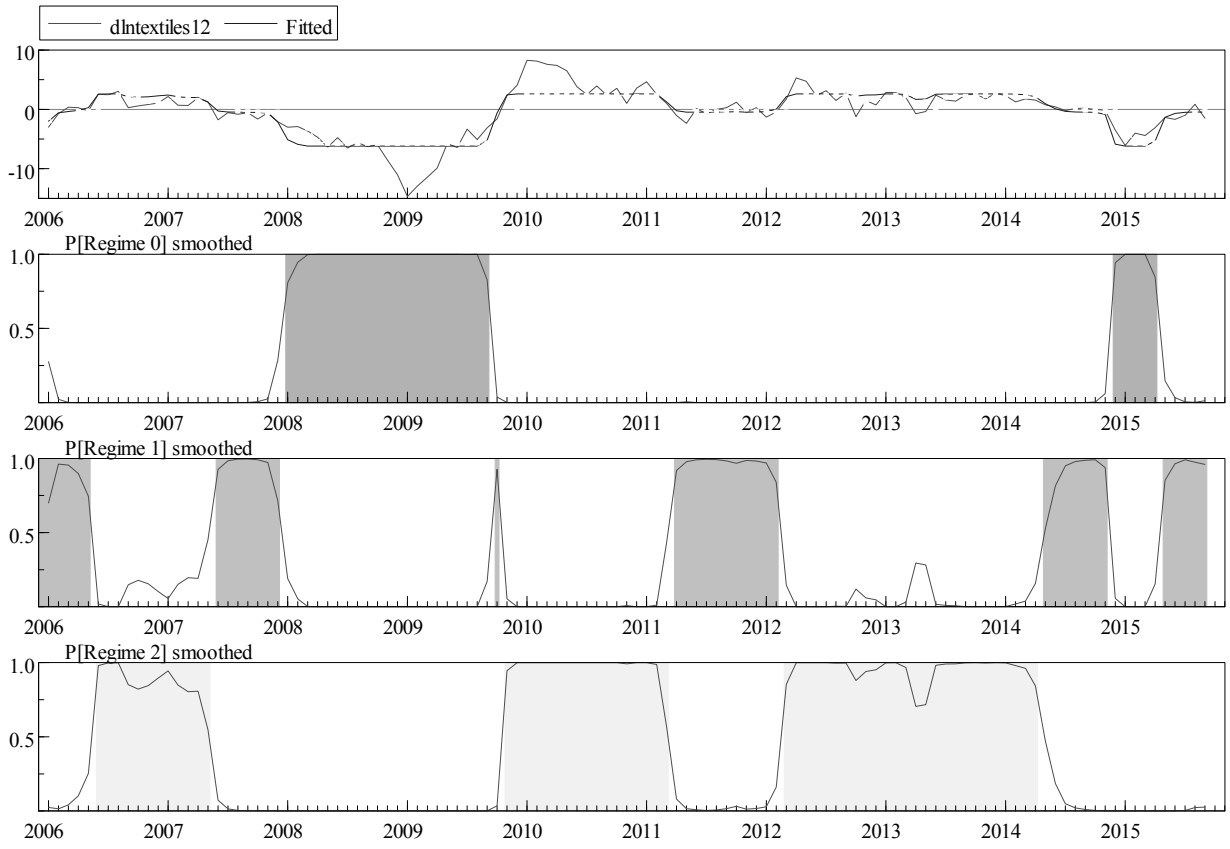

Figure 1. Smoothed Probabilities of Low, Moderate and High Growth States for the Textile Industry and Fitted Values

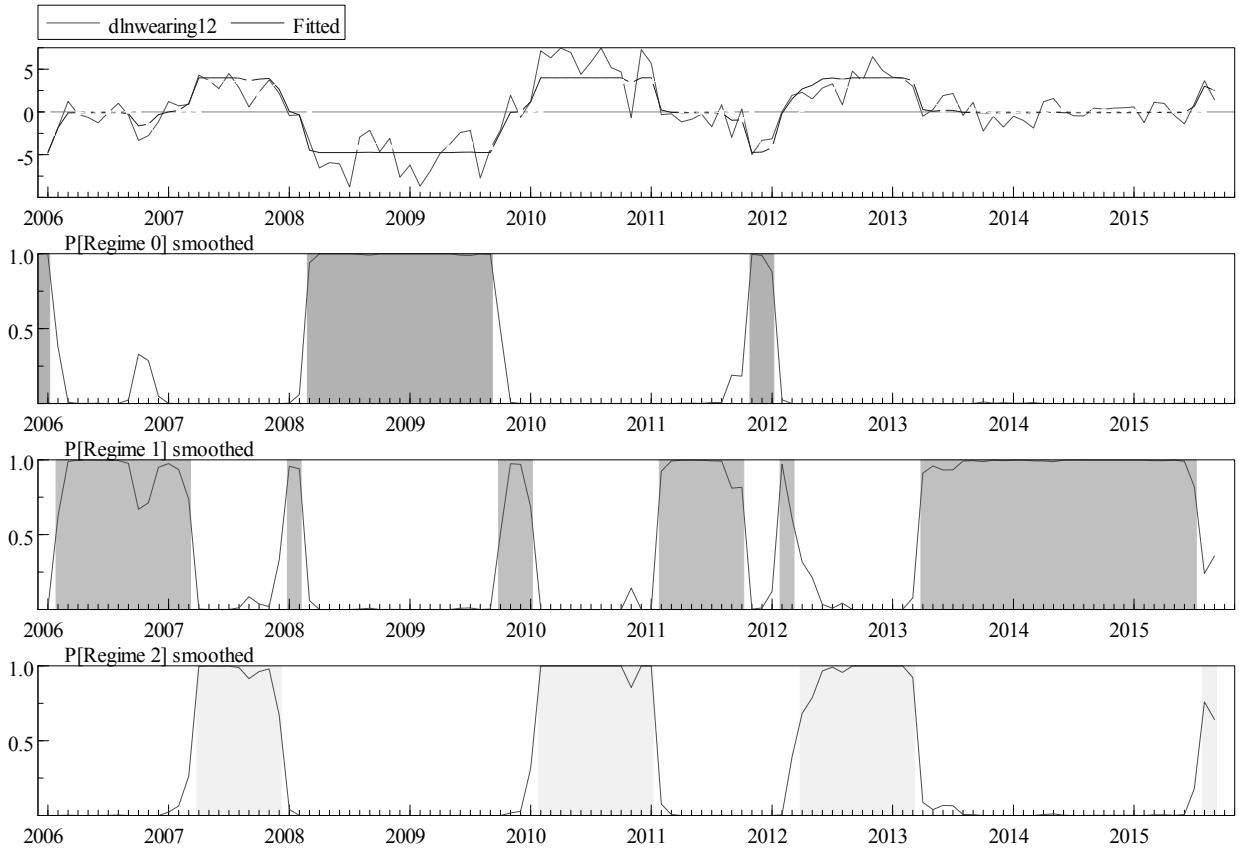

Figure 2. Smoothed Probabilities of Low, Moderate and High Growth States for the Apparel Industry and Fitted Values

of the textile and apparel industries are higher than the estimated variances of the moderate and high growth regimes. The textile and apparel industries have the highest volatility in the low growth regimes. The estimated growth rate of Turkish textile industry in low growth regime is -6.18%, whereas it grows by -0.47% and 2.61% in moderate and high growth phases. The estimated low growth rate for the Turkish apparel industry is -4.74%, whereas it grows by -0.08% and 3.99% in moderate and high growth phases, respectively.

Furthermore, the study determines the durations and persistences of staying in a particular regime by employing the estimated transition probabilities for the Turkish textile and apparel industries. The related results about that are given in Table 2 and Table 3.

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

	Turkish Textile Industry	**Turkish Apparel Industry**
Regime 0	0.91131	0.86618
Regime 1	0.84112	0.88259
Regime 2	0.92657	0.89637

Note: Regime 0 represents the low growth state for the textile and apparel industry, Regime 1 represents the moderate growth state for the textile and apparel industry, regime 2 represents the high growth state for the textile and apparel industry.

Table 3. Average durations and percentages of staying in the same state

	Turkish Textile Industry		**Turkish Apparel Industry**	
	Percentage	Avarage Duration	Percentage	Average Duration
Regime 0	22.22%	13.00	19.66%	7.67
Regime 1	30.77%	6.00	50.43%	9.83
Regime 2	47.01%	18.33	29.91%	8.75

Note: Regime 0 represents the low growth state for the textile and apparel industry, Regime 1 represents the moderate growth state for the textile and apparel industry, regime 2 represents the high growth state for the textile and apparel industry.

The average durations for the Turkish textile industry, are 13, 6, and 18.33 months for low, moderate and high growth regimes, while the average percentages are 22.22%, 30.77% and 47.01%, respectively. The probabilities of staying in the same regime for the next month are 0.91, 0.84, 0.92 for the low, moderate and high growth regimes. The high growth regime has the longest average duration and persistence for the Turkish textile industry. For the apparel industry, the average durations are 7.67, 9.83 and 8.75 months for the low, moderate and high growth regimes, while the average percentages are 19.66%, 50.43% and 29.91%, respectively and the probabilities of staying in the same regime for the next month are 0.86, 0.88, 0.89 for the low, moderate and

high growth regimes, respectively. The moderate growth regime in the Turkish apparel industry has the longest average duration and persistence.

4. CONCLUSION

Textile and apparel industries carry a remarkable role for the advancements of the industrial process of the Turkish economy, considering their contributions to structural transformation by creating value added, employment and foreign trade properties. They also have quite high weights among the other sub-sectors in total manufacturing industry with ratios of 8.92% and 6.59% for the textile and apparel industries, respectively. The study models the cyclical movements of the Turkish textile and apparel industries by employing hidden Markov regime switching models to provide a deep understanding on the asymmetric behavior of the cyclical characteristics of these industrial sectors, which allows to change the model parameters with regard to each different state of the economy. By utilizing this model on the textile and apparel sectors and investigate their asymmetric dynamics, we suggest a revealing analysis that can serve as a detailed reference for policymakers to design consistent and effective policies in order to increase the robustness of competitiveness in the global market. Considering the instable structure of the global markets, which is mainly caused by the capital flows and sudden changes in trade, the asymmetric characteristics become unavoidable for those sectors. In this context, the analyses that consider asymmetric behaviors should be take part in the policy making process. In order to reveal the characteristics of different states of these industries and provide the required information about their dynamics, the study examines nonlinearity, determines the number of regimes, provides regime classification and investigates the regime dependent heteroskedasticity. The study also employs the estimated transition probabilities to define and quantify the durations and persistences of staying in the same regime for the Turkish textile and apparel industries.

The results show that the Turkish textile and apparel industries exhibit strong asymmetric behavioral characteristics and there are three different states for the textile and apparel industries as low, moderate and high growth regimes. According to the results, the high growth regime has the longest average duration and persistence for the Turkish textile industry. For the apparel industry, the moderate growth regime has the longest average duration and persistence. It shows that the Turkish textile industry has more risky state than the Turkish apparel industry according to the relative estimated values of their variances. The estimated variance values also show that both of the textile and apparel industries have the highest volatility, and therefore have the highest risk in the low growth regimes.

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