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Araştırma Makalesi ● Research Article

Determination of Factors Affecting Textile Employment in Türkiye in the Context of Sectoral Employment: ARDL Bound and Hacker and Hatemi-J (2006) Causality Test

Türkiye'de Sektörel İstihdam Bağlamında Tekstil İstihdamını Etkileyen Faktörlerin Belirlenmesi: ARDL Sınır Testi ve Hacker ve Hatemi-J (2006) Nedensellik Analizi

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ÖZ

Sektörel istihdam, bir ülkenin ekonomik yapısının temel unsurlarından biridir ve tekstil sektörü, Türkiye'nin sanayileşmesi ve istihdam yaratması açısından kritik bir rol oynamaktadır. Bu çalışma, Türkiye'de 2009-2023 yılları arasında tekstil istihdamını etkileyen faktörleri, Gecikmesi Dağıtılmış Otoregresif (ARDL) sınır testi ve Hacker ve Hatemi-J (2006) nedensellik analizi kullanarak incelemektedir. Sonuçlar, reel efektif döviz kurunun istihdam üzerinde olumsuz bir etkisi olduğunu, tekstil işyeri sayısının ise anlamlı bir şekilde olumlu etkilediğini ortaya koymaktadır. Ayrıca, tekstil ithalatı ve Brent petrol fiyatlarının istihdam ile güçlü bir nedensel ilişkiye sahip olduğu, küresel ekonomik faktörlerin yerel iş yaratımı üzerindeki etkisini vurgulamaktadır. Bulgular, sektörün döviz dalgalanmalarına ve ticaret dinamiklerine karşı duyarlılığını göstermektedir. Döviz kurlarını istikrara kavuşturan ve tekstil sektöründe girişimciliği teşvik eden uzun vadeli politikalar, istihdamı artırabilir. Ayrıca, Türkiye'nin küresel piyasalara erişimini iyileştiren, elverişli anlaşmalar ve düşük tarifeler sağlayan dış ticaret politikaları, büyümeyi desteklemek için önemlidir. Enerji maliyetlerinin, özellikle petrol fiyatlarının ele alınması, büyük ölçüde ithal hammaddeye bağımlı olan tekstil sektörünün rekabetçiliğini sürdürmesi açısından kritik öneme sahiptir. Bu bulgular, sürdürülebilir istihdam büyümesini desteklemek ve dış şoklara karşı dayanıklılığı artırmak için koordineli dış ticaret, enerji ve sanayi politikalarının gerekliliğini vurgulamaktadır.

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A B S T R A C T

Sectoral employment is a vital component of a country's economic structure, with the textile industry playing a crucial role in Türkiye's industrialization and job creation. This study investigates the determinants of textile employment in Türkiye from 2009 to 2023, employing the Autoregressive Distributed Lag (ARDL) bound test and Hacker and Hatemi-J (2006) Causality analysis. The results reveal that the real effective exchange rate negatively impacts employment, while the number of textile workplaces has a significant positive effect. Furthermore, textile imports and Brent oil prices exhibit a strong causal relationship with employment, emphasizing the influence of global economic factors on domestic job creation. The findings highlight the sector's sensitivity to foreign exchange fluctuations and trade dynamics. Long-term policies stabilizing exchange rates and fostering entrepreneurship in the textile industry could enhance employment. Additionally, foreign trade policies that improve Türkiye's global market access through favorable agreements and reduced tariffs are essential for stimulating growth. Addressing energy costs, particularly oil prices, is crucial for maintaining competitiveness in the textile sector, which relies heavily on imported raw materials. These insights underscore the need for coordinated foreign trade, energy, and industrial policies to support sustainable employment growth and resilience against external shocks.

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Introduction

The manufacturing industry is crucial to a country's economic growth, job creation, technological advancement, and foreign trade balance. As manufacturing sectors increase their output, they contribute to accelerated economic growth. In addition to driving financial expansion, the labor-intensive nature of manufacturing creates a demand for a large workforce (Beşoluk, 2022; Javed & Suleri, 2019). Factors such as low labor costs, abundant raw material, sizeable domestic markets, and technological infrastructure investments are among the critical factors that have driven the manufacturing industry to Asian countries (Yang, 2016). In addition, global economic and political factors, trade agreements, and technology transfer have also contributed to this process. The combination of these factors has led to the growing importance of Asia in the manufacturing sector. China, in particular, has become the largest producer on a global scale in the manufacturing industry (Yu, 2022). According to 2021 data, nearly 1/3 of the world's manufacturing output ($15,962 billion) was realized in China ($4,909 billion). In addition, about 1/3 of China's employment is in manufacturing. China is followed by the US, Japan, and Germany regarding manufacturing output. However, the total output of these three countries is lower than that of China (ILO, 2023; World Bank, 2023a). While the value added by the manufacturing industry in Türkiye was $11,753.3 billion in 1980, it reached $181,887.5 billion in 2021, and the ratio of gross value added increased from 17% to 22%. In 1988, the share of manufacturing employment in total employment was 14,3%, while this share increased to 19.5% in 2021 (TurkStat, 2023; World Bank, 2023b). The textile sector is vital for the manufacturing industry and the Turkish economy.

The textile industry has emerged as a crucial sector within manufacturing, serving as a driving force for the Turkish economy. As of 2021, Türkiye ranked fourth globally in textile exports, with imports totaling $9.98 billion and exports reaching $16.16 billion (Republic of Türkiye Ministry of Industry and Technology, 2022). Most paid manufacturing workers in Türkiye are employed in the food, textile, clothing, and metal goods sectors (Republic of Türkiye Ministry of Industry and Technology, 2023), the textile sector employed 499,569 individuals in 2021, representing 11.3% of employment in the manufacturing industry (Republic of Türkiye Ministry of Industry and Technology, 2022).

Sectoral employment is vital for the healthy functioning of economic structures and for enhancing societal welfare. Specifically, sectoral employment directly contributes to economic expansion by boosting production by engaging the labor force in diverse sectors. Additionally, it fosters social justice by fostering income distribution equilibrium. A well-crafted sectoral employment policy aids in poverty reduction and fosters social harmony. Furthermore, diversification of sectors and enhanced competitiveness bolster economic resilience. By diversifying employment across sectors, the economy becomes more resilient to fluctuations and better equipped to handle external shocks.

This study employs the ARDL bounds test and Hacker and Hatemi-J (2006) Causality analysis to investigate the factors influencing textile employment in Türkiye. Unlike previous studies focusing on limited variables, this research considers a comprehensive range of factors affecting the textile sector. Prior literature has often overlooked the multitude of factors impacting employment and the unique characteristics of sub-sectors within manufacturing. This study evaluates the correlation between eight key factors directly affecting employment in the textile sector. Structurally, the study comprises four main sections. The introduction and literature review form the initial sections, providing context and background. The third section elaborates on the dataset and methodology utilized. Finally, the last section presents and discusses the findings derived from the analysis.

1. Theoretical background

Many studies investigate the relationship between economic growth and employment in Türkiye and worldwide. The effects of economic growth on employment are a controversial issue today. While some studies have failed to find evidence that economic growth reduces unemployment or that economic growth is associated with unemployment (Sadiku et al., 2015; Moroke et al., 2014), while the majority of studies have concluded that economic growth reduces unemployment to a greater or lesser extent (Muscatelli & Tirelli, 2001; Palombi et al., 2015; Tumanoska, 2020; Ball et al., 2015).The findings from international studies on the relationship between economic growth and unemployment overlap with the studies in Türkiye. Some of the studies have not found evidence that economic growth in Türkiye reduces unemployment or that there is a growth-employment relationship (Pehlivanoğlu & Tanga, 2016; Timur & Doğan, 2015), some of the studies have concluded that economic growth reduces unemployment more or less (Özer, 2022; Kolcu & Yamak, 2022). However, it should not be forgotten that the relationship between employment and growth may differ by sector. In this context, Mıhçı and Atılgan (2017) and Abdioğlu and Albayrak (2010) test the validity of Okun's Law in Türkiye for different periods and find that manufacturing industry production increases employment. Baskak (2023), using data from 1991-2019, found bidirectional causality between GDP and industrial employment.

The impact of energy costs on employment is multifaceted and involves many factors. However, in general, high-energy costs can reduce the profit margins of enterprises and affect their competitiveness, which can adversely affect employment. The costs of the oil crises of the 1970s had severe adverse effects on economic growth, inflation, and employment. Ordonez et al. (2019) conclude that oil prices decrease unemployment in a certain period and increase it in a certain period. In their study for the US, Keane and

Prasad (1996) concluded that the short-run and long-run effects of oil price shocks are different. Loungani (1986) concluded that increases in oil prices increase unemployment for 28 industries in the US. Doğrul and Soytaş (2010), for the period 2005-2009, found unidirectional causality from oil prices to unemployment rates in Türkiye. Güdenoğlu (2021) on the other hand, found causality from oil prices to unemployment rates in the short run in Türkiye and concluded that the effects of oil prices on industrial employment are asymmetric. Altay et al. (2013) concluded that there is a unidirectional effect from oil prices on employment in the short and long run for the years 2000–2012 in Türkiye. Azazi and Topkaya (2017) stated that although the change in oil prices caused fluctuations in the manufacturing industry employment rate between 1978 and 2014 in Türkiye, oil prices did not significantly affect manufacturing industry employment.

The impact of the real exchange rate on employment has been debated in many studies. Branson and Love (1988) found in their study for the United States that a depreciation in the exchange rate hurt employment in areas where durable consumer goods, including textiles, are produced in the manufacturing sector. Huang et al. (2014) concluded in their study for Canada that an increase in the real exchange rate reduced employment in the manufacturing industry. Bilgin and Danış (2005) identified a long-term relationship between the real exchange rate and employment in the ready-to-wear sector in Türkiye. Akyay (2021) found that an increase in the real exchange rate in Türkiye between 2009 and 2019 led to an increase in industrial employment. Filiztekin (2004) stated that the depreciation of the Turkish lira led to a decrease in industrial employment, highlighting the clothing sector as the most affected sector by the depreciation. Yenigün and Azazi (2022) investigated the impact of the exchange rate on industrial employment in Türkiye for the years 2000–2021. The study identified a long-term and stable relationship between the real exchange rate and industrial employment.

Foreign trade and changes in wage levels can affect employment. Although the prevailing view in the literature is that wage increases hurt employment and export increases have a positive impact on employment, studies have obtained different results for different periods, sectors, and countries. Whang (2019) found that exports positively affected employment in South Korea for the period 1980–2010, Feenstra et al. (2019) in the United States from 1991–2011. Bonga–Bonga and Biyase (2019) concluded that total employment in response to textile import shocks from China was adverse. Additionally, they stated that the South African manufacturing sector's total value added negatively responded to positive shocks from textile imports from China. Karaca (2021) using data from Türkiye in 2017, found that increasing entrepreneurship and imports reduced manufacturing employment, while exports and GDP growth increased manufacturing employment. Polat et al. (2011) examined the relationship between foreign trade, wages, and 22 manufacturing employment in Türkiye from 2003 to 2008, finding no significant impact of foreign trade on manufacturing employment and a negative effect on wages. Kien and Heo (2009) found that production increases increased industrial employment and decreased wage rates in Vietnam from 1999 to 2004. Köse and Avcı (2023) concluded in their study for Türkiye from 2009 to 2021 that long- and short-term increases in real wages increased manufacturing employment. Paun et al. (2021) concluded that minimum wages negatively affected employment in 22 EU countries from 1999 to 2016. Broecke et al. (2017) found in their study of 14 developing countries that minimum wages had a low and negative impact on employment. They also found that the adverse effects of minimum wages were more pronounced on young people and unskilled workers.

Phillips (1958) was the first person to conduct a study in the United Kingdom to determine the relationship between inflation, growth, and unemployment. Phillips identified an inverse and nonlinear relationship between nominal wages and unemployment in his study. Subsequently, many researchers have conducted studies on the validity of this relationship. Qin (2020) found that the Phillips curve was valid in the United States for the period 1962-2019 and Maduku and Kaseeram (2018) for South Africa for the period 1980–2017. Folawewo and Adeboje (2017) for the Economic Community of West African States countries for the period 1991-2014 and Krulický et al. (2022) for the Czech Republic for the period 2000-2021 found that the Phillips curve was not valid. In studies conducted for Türkiye, Akiş (2020) for the long term for the period 2005–2020 and Özer (2020) for the long term for the period 2006-2017 found that the Phillips curve was valid. However, Yıldırım and Sarı (2021) for the period 2005–2020, Kartal (2024) for the long term for the period 1960–2022 and Yıldırım (2020) for the long term for the period 2005–2017 found that the Phillips curve was not valid.

2. Research methodology

2.1 Data and variables

In analyzing factors influencing textile employment in Türkiye, Table 1 lists the variables considered. The number of textile workers is the dependent variable, while other variables are treated as independent variables within the model. Data for the number of textile workers (lntw) and textile enterprises (lntwp) were sourced from the Social Security Institution (SSI). The real effective exchange rate (lrer) and consumer price index (lcpı) data were sourced from the Central Bank of the Republic of Türkiye (CBRT). Dollar-based data for textile imports (ltı) and exports (lte) were obtained from the Turkish Statistical Institute (TurkStat). The industrial production index (lıpı) data came from TurkStat, while Brent crude oil (lbo) data were sourced from the U.S. Energy Information Administration (EIA). Additionally, the minimum wage, adjusted for real terms using the CPI (2003=100) index, was obtained from the

Ministry of Labor and Social Security (MoLSS). Our study employed the ARDL cointegration test as the econometric method due to the level of stationarity observed in some independent variables according to the ADF and One-Break ADF test results. The analysis encompassed monthly data spanning from 2009 to 2023.

Table 1: Characteristics of the dependent and independent variables

Data Set	Abbreviation	Source
Number of Textile Workers	lntw	SSI
Real Effective Exchange Rate	lrer	CBRT
Textile Total Imports	ltı	TurkStat
Textile Total Exports	lte	TurkStat
Brent Oil	lbo	EIA
Industrial Production Index	lıpı	TurkStat
Minimum Wage	lmw	MoLSS
Consumer Price Index	lcpı	CBRT
Number of Textile Workplaces	lntwp	SSI

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

Some adjustments were made to the dependent and independent variables before the analysis. The logarithms of all variables have been taken. In addition, the use of monthly data in the study highlights the problem of seasonality. In this context, the variables lntw, ltı, lntwp, and lntwp were subjected to a seasonal analysis using Census X-12.

2.2 ARDL bounds test

The ARDL (Autoregressive Distributed Lag) model is an econometric model used in the analysis of time series data. The ARDL model could consider both short-term and long-term effects together. This allows the ARDL model to have a flexible structure and analyze both short-term and long-term effects simultaneously. Due to its ability to handle stationarity issues in time series data, the ARDL model is widely used.

To conduct an ARDL bounds test, a regression model is first estimated that includes both the levels and first differences of the variables of interest. The lag length of autoregressive terms is typically selected based on standard information criteria such as the Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (BIC). If the F-statistic is significant at the chosen level of significance, it indicates the presence of a cointegration relationship and that the variables are related in the long run (Roy & Sharma, 2021)

The econometric model for the ARDL bounds test used in this study is shown as follows (Kong et al., 2021).

$$\begin{aligned}\mathrm{lntw} = {} & \alpha_0 + \sum_{i=1}^{p} \alpha_{1i}\,\Delta \mathrm{lntw}_{t-i} + \sum_{i=1}^{p} \alpha_{2i}\,\Delta \mathrm{lntwp}_{t-i} + \sum_{i=0}^{q} \alpha_{3i}\,\Delta \mathrm{lte}_{t-i} + \sum_{i=0}^{q} \alpha_{4i}\,\Delta \mathrm{lt\imath}_{t-i} + \sum_{i=0}^{q} \alpha_{5i}\,\Delta \mathrm{l\imath p\imath}_{t-i} \\ & + \sum_{i=0}^{q} \alpha_{6i}\,\Delta \mathrm{lcp\imath}_{t-i} + \sum_{i=0}^{q} \alpha_{7i}\,\Delta \mathrm{lmw}_{t-i} + \sum_{i=0}^{q} \alpha_{8i}\,\Delta \mathrm{lbo}_{t-1} + \sum_{i=0}^{q} \alpha_{9i}\,\Delta \mathrm{lrer}_{t-1} + \beta_1 \mathrm{lntw} \\ & + \beta_2 \mathrm{lntwp}_{t-1} + \beta_3 lnihr_{t-1} + \beta_4 lnith_{t-1} + \beta_5 \mathrm{l\imath p\imath}_{t-1} + k\beta_6 \mathrm{lcp\imath}_{t-1} \\ & + \beta_7 \mathrm{lmw} + \beta_8 \mathrm{lbo}_{t-1} + \beta_9 \mathrm{lrer}_{t-1} + u_t \end{aligned} \tag{1}$$

In equation (1); Δ is the first difference of the relevant series, α_0 slope coefficient, $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8$ *and* α_9 $\alpha_5, \alpha_6, \alpha_7, \alpha_8$ *and* α_9 coefficients indicate the short-run relationship between the variables, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$ *and* β_9 The coefficients denote the long-run relationship between the variables. The lag lengths used in the analysis are expressed with the help of Akaike (AIC) information criterion (Fousekis et al., 2016) F statistic calculated with the Wald test is compared with the significance values derived in Pesaran et al. (2001). If the F statistic value is greater than the upper limit of the table, the hypothesis it states that there is a long-run relationship between the variables. To analyze short-run relationships, the following Error Correction Model is estimated:

$$\begin{aligned}\Delta lntw_t = {} & \alpha_0 + \sum_{i=1}^{p} \alpha_{1i}\,\Delta lntw_t + \sum_{i=1}^{p} \alpha_{2i}\,\Delta lntwp_{t-i} + \sum_{i=0}^{q_1} \alpha_{3i}\,\Delta lte_{t-i} + \sum_{i=0}^{q_2} \alpha_{4i}\,\Delta lt\imath_{t-i} + \sum_{i=0}^{q_3} \alpha_{5i}\,\Delta l\imath p\imath_{t-i} \\ & + \sum_{i=0}^{q_4} \alpha_{6i}\,\Delta lcp\imath_{t-i} + \sum_{i=0}^{q_5} \alpha_{7i}\,\Delta lmw_{t-i} + \sum_{i=0}^{q_5} \alpha_{8i}\,\Delta lrer_{t-i} + \sum_{i=0}^{q_5} \alpha_{9i}\,\Delta lbo_{t-i} + n_1 ECT_{t-1} + \varepsilon_{\imath} \end{aligned} \tag{2}$$

In equation (2)ECT_{t-1} denotes the error correction term, which is the lagged value of the residuals of the model in which the long-run relationship is obtained. The coefficient of this term indicates how long it takes for a short-run shock to disappear and approach the long-run equilibrium value. However, for this to happen, the coefficient should be negative and statistically significant (Yılancı & Kırca, 2024).

2.3 Hacker and Hatemi-J (2006) Causality test

Hacker and Hatemi-J (2006) developed a causality test known as the "Hacker and Hatemi-J" causality test, widely used for examining causal relationships. This test represents an advancement over the Granger causality test and is employed explicitly to determine causality relationships in non-stationary time series data. Hacker and Hatemi-J (2006) argued that the results are stronger by following the Toda-Yamamoto causality procedure and using the bootstrap approach to determine critical values. Critical values are obtained with the bootstrap approach even though the errors are not normally distributed, minimizing the problem of "normal distribution of errors" (Beşoluk & Keskin, 2023). Toda-Yamamoto causality analysis is based on a lagged VAR model. The VAR(p) model is shown in equation (3) (Amiri & Ventelou, 2012).

$$Yt = \vartheta + A_1 Y_{t-1} + \ldots\ldots\ldots + A_p Y_{t-p} + \varepsilon_t \tag{3}$$

The equation in Equation (3)$\vartheta, Y_t\ and\ \varepsilon$ n-dimensional vector of variables, A is the parameter vector and p is the optimal lag length. Toda and Yamamoto (1995) propose the VAR model in equation (2) for causality analysis between integrated variables.

$$Y_t = \hat{\theta} + \hat{A}_1 Y_{t-1} + \ldots\ldots + \hat{A}_p Y_{t-p} + \ldots\ldots + \hat{A}_{p+d} Y_{t-p-d} + \hat{\varepsilon}_t \tag{4}$$

The negative signs on the variables in Equation (4) signify the least squares estimator. In this equation, the p data represent the number of lags determined beforehand, while the dmax data denote the maximum degree of integration of the variables. The null hypothesis in Toda-Yamamoto causality analysis posits that there is no causal relationship between the variables, whereas the alternative hypothesis contends that there is indeed a causal relationship between them (Toda & Yamamoto, 1995).

An important contribution of Hacker and Hatemi-J (2006) in the Toda-Yamamoto causality testing process is that it leads to stronger test results through the boostrap distribution of variables with small samples. According to Hacker and Hatemi-J (2006), in small samples X^2 distribution weakens the test performance. Hacker and Hatemi-J (2006) obtain the critical values by Monte Carlo simulation. Lag values are also calculated by Hacker and Hatemi-J (2006). Based on the information criteria, the HJC criterion is considered for the optimal lag length (Hacker & Hatemi-J, 2006).

3. Results and discussion

3.1 Descriptive statistics results

Table 2 presents the descriptive statistics of variables related to factors influencing textile employment in Türkiye. The highest average of 23.90 is attributed to the ltı variable, underscoring the significance of textile exports. Conversely, the lowest average of 4.29 pertains to the lbo variable, indicating a relatively lower impact of oil prices on textile employment. The lte, lmw, and lcpı variables exhibit right-skewness, whereas the remaining variables demonstrate left-skewness. This asymmetry highlights the diverse tendencies in the distributions of these variables.

Table 2: Descriptive statistics

Variables	lntw	lrer	ltı	lte	lbo	lıpı	lmw	lnwp	lcpı
Mean	12.93248	4.469551	23.29000	23.65963	4.291488	4.602200	6.260144	9.737956	5.780039
Median	12.96698	4.586101	23.28260	23.68210	4.314482	4.633226	6.248543	9.739409	5.624807
Maximum	13.17499	4.840005	23.80841	24.24733	4.835409	5.031691	6.809535	9.925396	7.386663
Minimum	12.55874	3.863043	22.71996	23.01420	3.124125	3.986124	6.005063	9.526537	5.077359
Std. Dev.	0.156706	0.265163	0.232399	0.229297	0.346956	0.262738	0.187155	0.098900	0.566306
Skewness	-0.758158	-0.640768	0.046242	-0.160094	-0.495796	-0.347498	0.419228	-0.324375	1.004994
Kurtosis	2.857110	2.066272	2.875126	3.734312	2.861435	2.455217	2.295965	2.781206	3.288623
Jarque-Bera	17.01062	18.43735	0.177077	4.706055	7.351347	5.718591	8.790259	3.437474	30.23794
Probability	0.000202	0.000099	0.915268	0.095081	0.025332	0.057309	0.012337	0.179292	0.000000
Sum	2276.116	786.6411	4099.040	4164.095	755.3019	809.9871	1101.785	1713.880	1017.287
Sum Sq. Dev.	4.297448	12.30451	9.451624	9.200966	21.06623	12.08043	6.129735	1.711716	56.12287
Observations	**176**	**176**	**176**	**176**	**176**	**176**	**176**	**176**	**176**

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

Jarque-Bera is a test statistic used to test the assumption of normal distribution. Upon examining the variables, it is understood that the variables ltı, lte, lıpı, and lntwp follow a normal distribution, while the others do not. Graphical representations of the variables are provided in Figure 1. Upon reviewing the graphs, it is observed that all variables except lrer experienced significant increases between 2009 and 2023. There is also a noticeable downward trend in the lrer variable in recent years. The graphs also indicate the impact of Covid-19, particularly in 2020. Therefore, considering both the trend effects and structural breaks, structural break tests should be considered in unit root tests.

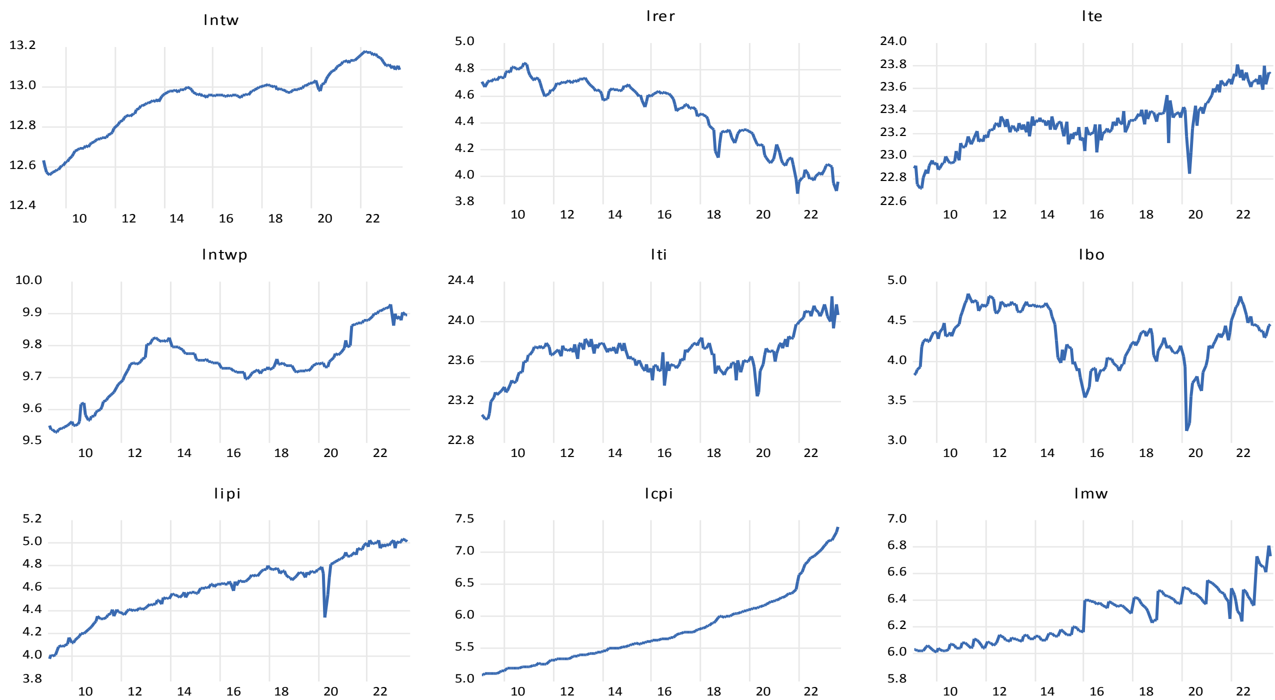

Figure 1: Variable graphs

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

3.2 Unit root test results

The unit root test results of the variables are crucial in selecting the ARDL cointegration test. Considering the graphs of the variables, both the classical ADF unit root test and the ADF unit root test with a single break were applied in our study. The unit root test results in Table 3 show that the variables lmw and lıpı are stationary at the 1% significance level. The variables lrer, lntwp, ltı, and lte are first-order stationary at the 1% significance level. The lbo variable is observed to be stationary in the constant term at the 10% significance level and first-order stationary at the 1% significance level. The lntw variable is found to be stationary in the constant term at the 5% significance level and first-order stationary at the 1% significance level. The lcpı variable has first-order stationarity at the 5% significance level.

Table 3: ADF unit root test results

Variable Name		Level		1st difference	
		t statistics	p value	t statistics	p value
lntw	Intercept	-3.1929	0.0221**	-7.1302	0.0000***
	Trend &Intercept	-2.0873	0.5488	-	-
lrer	Intercept	0.0519	0.9611	-10.7569	0.0000***
	Trend &Intercept	-3.0985	0.1100	-	-
lntwp	Intercept	-1.1880	0.6794	-14.0361	0.0000***
	Trend &Intercept	-1.4471	0.8436	-	-
lcpı	Intercept	4.3671	1.0000	-2.9835	0.0385**
	Trend &Intercept	2.7360	1.0000	-	-

lmw	Intercept	-0.2835	0.9234	-3.1446	0.0253**
	Trend &Intercept	-4.2232	0.0052***	-	-
ltı	Intercept	-2.1604	0.2217	-22.0215	0.0000***
	Trend &Intercept	-2.3144	0.4235	-	-
lte	Intercept	-1.4267	0.5682	-23.9880	0.0000***
	Trend &Intercept	-3.1163	0.1058	-	-
lıpı	Intercept	-1.8364	0.3620	-10.5096	0.0000***
	Trend &Intercept	-4.5432	0.0017***	-	-
lbo	Intercept	-2.6054	0.0938*	-11.1977	0.0000***
	Trend &Intercept	-2.8078	0.1965	-	-

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

The Single-Break ADF Unit Root Test is a statistical test used to examine the presence of a unit root in time series data, considering a single structural break. The traditional ADF Unit Root Test assumes a single trend or structural break across all observations in the time series. However, this assumption of a single structural break may not always hold in time series data. The Single-Break ADF Unit Root Test considers a significant change in the time series structure to assess the presence of a unit root.

Table 4 displays the outcomes of the ADF unit root test with a single break. According to the table, the lmw variable is observed to be stationary at the 1% significance level based on both the constant and trend values, with the break occurring in December 2015. Similarly, the Lte variable is deemed stationary at the 1% significance level according to the constant and trend values, with the break taking place in February 2010. Additionally, the lıpı variable is found to be stationary at the 1% significance level based on both the constant and trend values, with the break period occurring in April 2020. It is plausible to attribute this break to the impact of the Covid-19 pandemic. Furthermore, it is noted that the other variables are first-order stationary at the 1% significance level. The lntw variable experienced a break in May 2009, the lrer variable in August 2018, the lntwp variable in May 2021, the lcpı variable in March 2021, the ltı variable in April 2020, and the lbo variable in March 2020. These break dates predominantly fall in 2020, reflecting the influence of the pandemic on economic variables during that period.

Table 4: ADF unit root test results with single break

Variable Name		Level			1st difference		
		t statistics	p value	Break Date	t statistics	p value	Break Date
lntw	Intercept	-4.294180	0.0757*	2020M05	-12.42349	< 0.01	2009M05
	Trend &Intercept	-2.958206	0.9235	2011M8	-	-	-
lrer	Intercept	-2.197382	0.9631	2017M09	-11.64290	< 0.01	2018M08
	Trend &Intercept	-4.132368	0.2968	2011M12	-	-	-
lntwp	Intercept	-2.627337	0.8597	2020M05	-15.18445	< 0.01	2021M05
	Trend &Intercept	-2.639116	0.9731	2014M12	-	-	-
lcpı	Intercept	1.046470	1.000	2021M10	-7.831644	< 0.01	2021M03
	Trend &Intercept	-3.921402	0.4222	2021M11	-	-	-
lmw	Intercept	-2.803380	0.7859	2015M12	-14.97480	< 0.01	2009M07
	Trend &Intercept	-6.799350	<0.01***	2015M12	-	-	-
ltı	Intercept	-4.490218	0.0444**	2020M05	-23.77377	< 0.01	2020M04
	Trend &Intercept	-3.741351	0.5378	2020M05	-	-	-
lte	Intercept	-4.845831	0.0154**	2020M05	-25.43402	< 0.01	2020M06
	Trend &Intercept	-5.991961	<0.01***	2010M02	-	-	-
lıpı	Intercept	-5.340988	<0.01***	2020M04	-16.87888	< 0.01	2020M06
	Trend &Intercept	-6.900730	<0.01***	2020M04	-	-	-
lbo	Intercept	-3.804892	0.2339	2014M06	-14.53425	< 0.01	2020M03
	Trend &Intercept	-4.747345	0.0680*	2014M08	-	-	-

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

3.3 ARDL bound test results

The first stage of the ARDL model is to examine the stationarity of the variables with unit root tests. In the second step, model selection is made. In this step, the most appropriate model is determined according to the results of the bounds tests and econometric criteria (AIC). The model selection for ARDL is preferred as ARDL (4, 2, 3, 3, 3, 4, 0, 0, 0, 4, 4, 1, 4) according to the AIC criterion. In this study, the model selection graph for the AIC criterion for model selection is given in Appendix 1, and the lag value is set at 4. There are dummy variables among the estimated model selection. The reason for including these dummy variables in the model is that the CUSUM tests had structural breaks in the previous model estimation results. The model was re-estimated by assigning dummy variables to the break periods.

Following the selection of the ARDL model, several preliminary tests should be conducted. One of these tests is the Jarque-Bera test, which assesses the normality of error terms. A Jarque-Bera test result exceeding 0.05 suggests normality of error terms, as observed in the results. Another crucial consideration in ARDL bounds testing is the issue of heteroskedasticity, where the variance of error terms in a regression model fluctuates. The Breusch-Pagan-Godfrey test was utilized to examine this issue, with a prob. value exceeding 0.05 indicating the absence of heteroskedasticity in the model. Autocorrelation among independent variables is another important assumption and pretest. Table 5 presents the test results, with an F statistic prob. value above 0.05 indicating no autocorrelation problem among the independent variables. Lastly, a specification error analysis was conducted to check for errors in the model setup. The Ramsey reset test results indicated that the significance of t-stat and F-stat values exceeded 0.05, affirming the absence of errors in the model specification.

Table 5: ARDL pre-test results

Pretests	Coefficients	Prob.
Jarque-Bera	0.08	0.96
Breusch-Pagan-Godfrey (F-stat)	0.90	0.62
Breusch-Godfrey Serial Correlation LM Test (F-stat)	0.46	0.63
Ramsey Reset Test t-stat	1.40	0.16
Ramsey Reset Test F-stat	1.98	0.16

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

One of the assumptions underlying the ARDL model is the CUSUM (Cumulative Sum) and CUSUMQ tests. These tests are statistical tools used to detect structural breaks in the parameters of a regression model. Figure 2 displays the graphs of CUSUM and CUSUMQ structural break tests developed by Brown et al. (1975). The results depicted in Figure 2 indicate the absence of any structural breaks in both graphs.

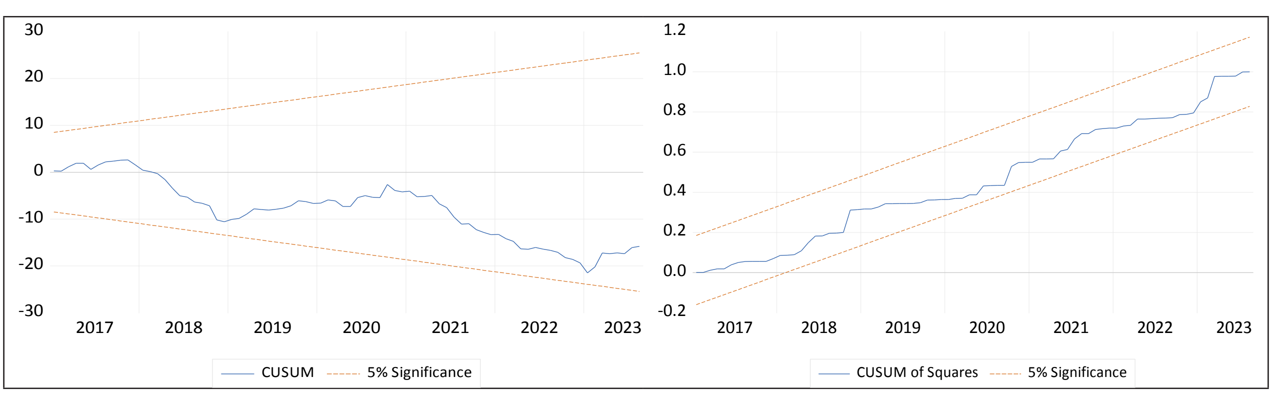

Figure 2: CUSUM and CUSUMSQ test results

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

Once the model assumptions are satisfied, the ARDL bounds test results can be interpreted appropriately. The ARDL bounds test outcomes are presented in Table 6, where the F statistic value is calculated as 3.408. This outcome signifies a cointegration relationship at the lower bound I (0) and upper bound I (1) values at a significance level of 1%. In essence, it is inferred that a cointegration relationship exists at the 1% significance level for both bounds.

Table 6: ARDL bound test results

k	F stat	I (0)	I (1)	Sign.
9	3.408	1.8	2.8	10%
		2.04	2.08	5%
		2.24	3.35	%2.5
		2.5	3.68	1%

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

The long-run results of the ARDL bounds test are summarized in Table 7. As per the test outcomes, a 1% rise in the real effective exchange rate is associated with a 0.31% decline in the number of textile employees at a significance level of 5%. Conversely, a 1% increase in the number of textile workplaces results in a 0.99% increase in the number of textile employees at a significance level of 1%. Notably, the strongest relationship coefficient is observed between these two variables. Furthermore, in the long-run coefficients, the impact of other variables on the number of textile employees is not deemed statistically significant. Specifically, a 1% increase in the CPI index leads to a marginal 0.01% decrease in the number of textile employees, but this effect is not statistically significant at the 5% significance level.

Table 7: ARDL long run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lrer	-0.317036	0.162349	-1.952805	0.0529*
lte	-0.108881	0.206698	-0.526762	0.5992
lntwp	0.992197	0.247247	4.012984	0.0001***
ltı	0.026698	0.116979	0.228228	0.8198
lbo	-0.018386	0.053110	-0.346188	0.7297
lıpı	0.263849	0.169903	1.552939	0.1227
lcpı	-0.234521	0.096147	-2.439193	0.0160**
lmw	0.240137	0.183802	1.306499	0.1936
Dummy	0.002171	0.025655	0.084642	0.9327
C	5.333232	3.603587	1.479979	0.1412

Note: (*) Significant at the 10%; (**) Significant at the 5% and %; (***) Significant at the 1%.

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

The ARDL long-run coefficient for the real effective exchange rate highlights the sensitivity of firms in the textile sector to changes in exchange rates. Given that textile sector exports account for 5% to 8% of Türkiye's economy, it suggests that increases in the real effective exchange rate could impact textile employment in the long term. Moreover, the negative correlation between the CPI index and the number of textile employees suggests that inflation in Türkiye might reduce enterprise employment by increasing cost pressures. A rise in the CPI index typically signifies higher consumer prices, leading to reduced purchasing power for consumers. This can result in decreased demand for businesses in the textile sector, potentially impacting profitability and leading to production cuts or workforce reductions. On a positive note, the positive relationship between the increase in the number of textile workplaces and the number of textile employees indicates that employment could rise with the establishment of new workplaces.

The ARDL Error Correction Model was employed to explore the short-run dynamics among the variables, and the estimation results are detailed in Table 8. The R-squared (R^2) value for the ARDL Error Correction Model stands at 0.69, with an adjusted R-squared of 0.63.

In the results of the error correction model, the error correction coefficient (ECM-1) is negative and statistically significant, aligning with expectations. This implies that deviations from equilibrium in the short run tend to converge towards equilibrium in the long run. The estimated value of this coefficient is -0.06, indicating that approximately 6% of deviations from the long-run equilibrium following short-run shocks can be rectified after one period, highlighting a gradual adjustment process.

Table 8: ARDL short run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lntw(-1)	-0.061438	0.069907	-0.878851	0.3810
lntw(-2)	0.175346	0.059786	2.932881	0.0039***
lntw(-3)	0.230167	0.056893	4.045624	0.0001***
lrer	-0.000746	0.014837	-0.050308	0.9599
lrer(-1)	0.032079	0.017451	1.838188	0.0682*
lte	0.002361	0.008150	0.289661	0.7725
lte(-1)	0.013363	0.009548	1.399629	0.1639
lte(-2)	-0.016645	0.008191	-2.032058	0.0441**
ltı	0.048971	0.008541	5.733586	0.0000***
ltı(-1)	0.004497	0.009258	0.485756	0.6279
ltı(-2)	0.035733	0.009236	3.868734	0.0002***
ltı(-3)	-0.021751	0.007779	-2.796197	0.0059***
lcpı	0.010745	0.037159	0.289169	0.7729
lcpı(-1)	0.016257	0.041547	0.391286	0.6962
lcpı(-2)	0.074482	0.042420	1.755803	0.0814*
lcpı(-3)	-0.095192	0.035033	-2.717227	0.0074***
lmw	-0.007951	0.008795	-0.903964	0.3676
lmw(-1)	-0.015314	0.008546	-1.791939	0.0753*
lmw(-2)	0.011565	0.008517	1.357825	0.1768
lmw(-3)	-0.015449	0.008996	-1.717300	0.0882*
Dummy	-0.006856	0.003439	-1.993296	0.0482**
Dummy(-1)	-0.003794	0.003294	-1.151720	0.2514
Dummy(-2)	-0.007365	0.003460	-2.128435	0.0351**
Dummy(-3)	0.009328	0.003456	2.698910	0.0078***
CointEq(-1)*	-0.067341	0.010617	-6.342596	0.0000***

Note: (*)Significant at the 10%; (**)Significant at the 5% and %; (***)Significant at the 1%.

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

According to the error correction results, a 1% increase in the two and three-period lagged values of textile workers in the short-term leads to a 0.17% and 0.23% increase, respectively, in textile workers in the current period at a 1% significance level. Additionally, a 1% increase in textile imports is associated with a 0.04% increase in the number of textile workers at the 1% significance level. However, a negative relationship is observed for the third lag of textile imports. This indicates that the significance of raw materials and energy inputs in textiles can positively impact textile production and consequently employment in current periods.

Regarding textile exports, a 1% increase in textile exports in the two-period lag may result in a 0.01% decrease in the number of textile workers at the 5% significance level. Analyzing the Consumer Price Index (CPI), a 1% increase in the third lag period leads to a 0.09% decrease in the number of textile workers. Inflation, due to its cost pressures even in the short term, can reduce the number of textile workers, especially in periods with higher inflation rates three months prior.

3.4 Hacker and Hatemi-J (2006) Causality test results

The causality test results between textile employment and other variables in Türkiye are outlined in Table 9. The Hacker and Hatemi-J (2006) Causality test results are determined based on Wald statistic values exceeding critical values. If the Wald statistic value surpasses the critical value, then a causal relationship can be inferred. Additionally, the HJC criteria were taken into account to determine the optimal lag length when selecting delay values. If one of the variables demonstrates varying levels of stationarity, an additional lag value is incorporated into the model. In this analysis, since the stationarity levels of the lıpı and lmw variables are at the same level, an additional lag value of 1 was set. The HTC optimal lag length was determined as 1 for the lmw variable and 3 for the other variables. According to Table 9, a significant causal relationship is observed at the 1% significance level from textile imports and Brent oil prices to textile employment. Furthermore, there is a causal relationship at the 10% significance level from the number of textile workplaces and the industrial production index to textile employment. However, no statistically significant causal relationship was identified among the other variables.

Table 9: Hacker and Hatemi-J (2006) Causality test results

Hypotheses	WALD Stat.	Critic Value (1%)	Critic Value (5%)	Critic Value (10%)	Lag+Add. Lag
lrer ⇏ lntw	2.846	11.797	8.204	6.594	3+0
lntw ⇏ lrer	4.073	15.678	11.291	9.328	3+0
lte ⇏ lntw	5.273	13.102	8.415	6.679	3+0
lntw ⇏ lte	6.739	17.849	12.270	9.997	3+0
ltı ⇏ lntw	10.120**	13.259	8.758	6.805	3+0
lntw ⇏ ltı	0.778	15.516	10.766	8.507	3+0
lntwp ⇏ lntw	7.736*	13.074	8.866	6.980	3+0
lntw ⇏ lntwp	7.962	16.105	11.106	8.772	3+0
lcpı ⇏ lntw	2.616	13.299	8.800	6.918	3+0
lntw ⇏ lcpı	2.791	14.179	9.319	7.298	3+0
lbo ⇏ lntw	32.346***	13.331	8.397	6.604	3+0
lntw ⇏ lbo	2.842	14.712	9.701	7.716	3+0
lıpı ⇏ lntw	8.366*	17.053	8.738	6.428	3+1
lntw ⇏ lıpı	2.995	14.926	8.832	6.650	3+1
lmw ⇏ lntw	0.021	7.302	3.825	2.648	1+1
lntw ⇏ lmw	1.059	7.462	3.886	2.695	1+1

Note: (*)Significant at the 10%; (**)Significant at the 5% and %; (***)Significant at the 1%.

Source: own based on SSI, CBRT, TurkStat, EIA, MoLSS (2009-2023)

In Türkiye, imports of intermediate goods in industrial products are high, while raw materials and energy inputs also affect costs. Causality results reveal that textile imports and Brent oil prices strongly correlate with the number of textile employees. Moreover, the significant share of textile exports can explain the strong relationship between the industrial production index and the number of textile employees. The entry of new firms into the market in the textile sector can be considered as an important issue affecting the number of textile employees.

Conclusion

Sectoral employment is critical in employment, economic development, and societal welfare. Increased employment in specific sectors enhances their production and value-added capacity, supporting economic growth. Our study focuses on the textile sector, one of Türkiye's critical sectors with significant production and export shares. Turkish textile products are in demand in global markets due to their quality and competitive prices, contributing to Türkiye's trade income and helping to offset the current account deficit. Furthermore, the textile sector occupies a prominent position in Türkiye's industrial production, contributing to developing the country's industrial infrastructure and adapting to technological innovations.

We examine factors influencing textile employment in Türkiye using the ARDL model and Hacker and Hatemi-J (2006) Causality analysis, covering the monthly period from 2009 to 2023. According to the ARDL results, the real effective exchange rate, the number of textile workplaces, textile imports, and textile exports influenced textile employment. Hacker and Hatemi-J (2006) Causality test results also indicate a strong relationship between Brent oil, textile imports, industrial production index, the number of textile workplaces, and the number of textile workers. These findings play a crucial role in determining employment policies and strategies in the textile sector. The real effective exchange rate is a significant factor affecting the competitiveness of firms in the textile sector. Considering its impact on textile exports and imports, the central bank's exchange rate policies are crucial for the country. Particularly, exchange rate fluctuations can affect costs for textile exporters and reduce competitiveness. Therefore, firms must use financial instruments to manage exchange rate risks or develop policies that protect against fluctuations. Effectively managing trade policies is essential to enhance the international competitiveness of firms in the textile sector. Trade facilitation can be provided to support imports and exports, reduce customs duties and trade barriers, and facilitate access to international markets through favorable trade agreements. Moreover, effective management of trade policies to enhance the international competitiveness of firms in the textile sector is crucial for opening new workplaces. Trade facilitation can be provided to support imports and exports, reduce customs duties and trade barriers, and update trade agreements favorably to facilitate access to international markets.

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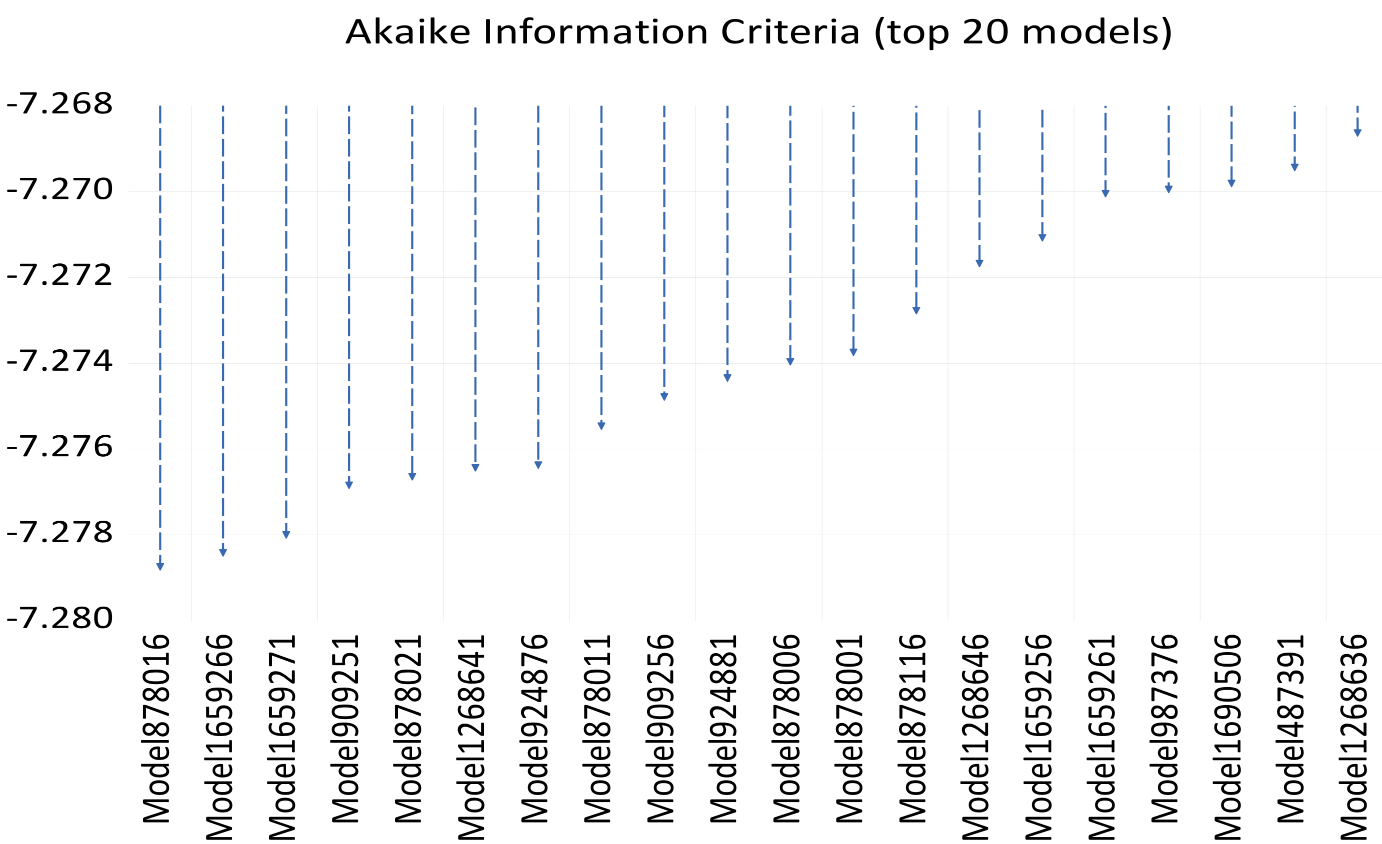
Appendix

Appendix 1



Model878016: ARDL(4, 2, 3, 3, 4, 0, 0, 4, 1, 4)
Model1659266: ARDL(4, 0, 3, 3, 4, 0, 0, 4, 1, 4)
Model1659271: ARDL(4, 0, 3, 3, 4, 0, 0, 4, 0, 4)
Model909251: ARDL(4, 2, 3, 1, 4, 0, 0, 4, 4, 4)
Model878021: ARDL(4, 2, 3, 3, 4, 0, 0, 4, 0, 4)
Model1268641: ARDL(4, 1, 3, 3, 4, 0, 0, 4, 1, 4)
Model924876: ARDL(4, 2, 3, 0, 4, 0, 0, 4, 4, 4)
Model878011: ARDL(4, 2, 3, 3, 4, 0, 0, 4, 2, 4)
Model909256: ARDL(4, 2, 3, 1, 4, 0, 0, 4, 3, 4)
Model924881: ARDL(4, 2, 3, 0, 4, 0, 0, 4, 3, 4)
Model878006: ARDL(4, 2, 3, 3, 4, 0, 0, 4, 3, 4)
Model878001: ARDL(4, 2, 3, 3, 4, 0, 0, 4, 4, 4)
Model878116: ARDL(4, 2, 3, 3, 4, 0, 0, 0, 1, 4)
Model1268646: ARDL(4, 1, 3, 3, 4, 0, 0, 4, 0, 4)
Model1659256: ARDL(4, 0, 3, 3, 4, 0, 0, 4, 3, 4)
Model1659261: ARDL(4, 0, 3, 3, 4, 0, 0, 4, 2, 4)
Model987376: ARDL(4, 2, 2, 1, 4, 0, 0, 4, 4, 4)
Model1690506: ARDL(4, 0, 3, 1, 4, 0, 0, 4, 3, 4)
Model487391: ARDL(4, 3, 3, 3, 4, 0, 0, 4, 1, 4)
Model1268636: ARDL(4, 1, 3, 3, 4, 0, 0, 4, 2, 4)