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The Importance of Non-Precarious Employment and Its Relationship with Broadly Defined Unemployment: Fourier-Shin Approach[1]

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Eğreti Olmayan İstihdamın Önemi ve Geniş Tanımlı İşsizlik ile İlişkisi: Fourier-Shin Yaklaşımı[2]

Abstract

This study aims to emphasise the importance of a skilled labor force within the context of Türkiye's Decent Work Policy. It examines the long-term relationship between non-precarious employment and broadly defined unemployment, using quarterly data from 2009 to 2023. The long-term relationship between the series, found to be stationary at the first difference, was analysed by using the Fourier-Shin cointegration test. Given the results of FMOLS, DOLS, and CCR estimators, all results were statistically significant. It was concluded that broadly defined unemployment caused a change between 0.66% and 0.69% in non-precarious employment in the long term, and the opposite effect occurred. The study's calculation of non-precarious employment and broadly defined unemployment variables, as well as the examination of the relationship between these two variables for the first time, makes the study original.

Keywords : Non-Precarious Employment, Broadly Defined Unemployment, Long-Term Relationship, Fourier-Shin Cointegration Test.

JEL Classification Codes : CO1, E20, E24.

Öz

Bu çalışmada, Türkiye'nin İnsana Yakışır İş Politikası kapsamında nitelikli işgücünün önemi vurgulanmakta ve 2009-2023 dönemine ait üç aylık veriler kullanılarak eğreti olmayan istihdam ile geniş tanımlı işsizlik arasındaki uzun dönemli ilişki incelenmektedir. Birinci farkta durağan olduğu bulunan seriler arasındaki uzun dönemli ilişki, Fourier Shin eşbütünleşme testi kullanılarak analiz edilmiştir. FMOLS, DOLS ve CCR tahmin edicilerinin sonuçlarına bakıldığında, tüm sonuçlar istatistiksel olarak anlamlıdır. Geniş tanımlı işsizliğin uzun dönemde eğreti olmayan istihdamda %0,66 ile %0,69 arasında, ters yönde değişime neden olduğu sonucuna varılmıştır. Çalışmada eğreti olmayan istihdam ve geniş tanımlı işsizlik değişkenlerinin yazarlar tarafından hesaplanması ve bu iki değişken arasındaki ilişkinin ilk kez inceleniyor olması çalışmayı özgün kılmaktadır.

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Anahtar Sözcükler : Eğreti Olmayan İstihdam, Geniş Tanımlı İşsizlik, Uzun Dönem İlişki, Fourier-Shin Eşbütünleşme Testi.

1. Introduction

Before the 1970s, the employment market was dominated by standard employment characterised by security and stability. However, as a result of the restructuring and reorganisation of the capital accumulation regime brought about by the capitalist system in the 1980s, the flexibilisation of labor led to the proliferation of non-standard types of employment. The globalisation process, which accompanied the capitalist system, facilitated the segmentation of production, internationalisation, and the spread of multinational corporations, thereby increasing subcontracting and leading to a higher level of uncertainty, insecurity, and, consequently, precariousness in the labor market. This precarization also led to an increase in female employment, with women being employed in more cost-effective and easily dismissible jobs. Young people entering the labor market at an early age to earn income contributed to the spread of temporary and part-time jobs. Similarly, high unemployment rates forced individuals to take on part-time and temporary jobs reluctantly to sustain their livelihoods. The employment types proposed as solutions to unemployment, such as part-time and temporary employment, increased the potential for employment in precarious job types. Precarious employment types have continued to rise due to economic crises, government policies, and global factors.

The COVID-19 pandemic, which has led to numerous problems worldwide, has caused disruptions and uncertainties in the labor market. The Social Policy Implementation and Research Center (SPM) introduced the concept of "non-precarious employment," inspired by the idea of "precarious employment," which has limited use in the current literature, referring to those employed full-time in non-agricultural jobs and covered by social security. This concept was published in September 2020, highlighting anomalies in labor and unemployment dynamics caused by the pandemic, as reported by the Turkish Statistical Institute.

In the literature, researchers such as Rodgers (1989), Kalleberg (2000), Cranford et al. (2003), Temiz (2004), Hipp et al. (2015), and Kretsos and Livanos (2016) claim that precarious employment is common in part-time, temporary, or short-term jobs. Furthermore, Bosch (2004), Green and Livanos (2015), Alkan (2021), and Ferre (2021) argue that high unemployment forces individuals to reluctantly work in part-time, temporary, remote, hidden, or illegal jobs.

The present study examines non-precarious employment, which is characterised by quality and qualification, as often emphasised in sustainable development plans, as "decent work." Accordingly, this study examines the relationship between non-precarious employment and unemployment, building on the conclusion stressed in the literature that unemployment often leads to precarious employment. To comprehensively address

unemployment and incorporate the concept of precarious employment, this study employs a broadly defined unemployment variable, calculated by adding the potential labour force and time-related underemployment to the narrowly defined unemployment variable. The absence of studies using the concept of non-precarious employment and the calculation of variables by the authors makes this study unique. The quarterly data of the 2009-2023 period were used to calculate the variables of non-precarious employment and broadly defined unemployment. Considering the potential for structural breaks, tests incorporating Fourier functions to account for smooth breaks were used in the process.

2. The Concept and Importance of Non-Precarious Employment

Employment, a concept related to people, is defined as "*a person being employed in a job or task.*" It refers to the working-age population engaged in any activity to produce goods or provide services for a wage or profit during a short reference period (ILO, 2022: 8).

Precarious employment will be discussed before addressing non-precarious employment. Precarious employment is a broad concept with multiple definitions. The International Labour Organization (ILO) defines precarious employment as *a type of employment characterised by uncertainty regarding the duration of employment, lack of access to social protection and employment-related benefits, multiple potential employers or unclear/hidden employment relationships, low wages, and significant legal and practical barriers to union membership and collective bargaining* (ILO, 2012: 27). In the economic literature, Rodgers (1989) proposes four criteria to determine precarious employment. The first criterion is whether the job has a specified duration or involves a high likelihood of the worker losing their current job. The second criterion is the limited or nonexistent control that the worker has over their job. The third criterion is the lack of social assistance and social security packages as part of the worker's current job. The fourth and final criterion is that the worker's income creates a state of poverty. Rodgers (1989) defines precarious employment as characterised by instability, a lack of social rights, insecurity, and social and economic disadvantage (Rodgers, 1989: 3). Similarly, Amable et al. (2001) describe it in terms of instability, vulnerability, inadequate wages, uncertainty, and reduced social benefits. Vosko (2010) defines precarious employment as a significant global problem, where workers, unlike businesses and governments, bear the risks associated with employment and face job uncertainty, instability, and insecurity with limited social benefits and legal rights (Vosko, 2010: 2). Precarious employment is a multi-dimensional and multi-faceted concept with numerous different definitions. In this context, Fleury and Cahill (2018) argue that there is no standard definition and describe it as a "bad job".

In the 1980s, as a result of the restructuring and regulation brought about by the capital accumulation regime created by the capitalist system, the concepts of atypical employment, non-standard employment, and precarious employment, collectively referred to as flexible employment types, gained widespread recognition. The intensely competitive environment brought about by the global economy has compelled enterprises to be flexible

in both their production processes and work organisation. Flexible production has also brought labor market flexibility, which contradicts the concept of secure jobs. Labor market flexibility involves issues such as the fragmentation of the labor force, fewer regulations at workplaces, wage structures dependent on economic fluctuations, weaker union organisations and the resulting individualisation of collective bargaining, and lower social rights (Munck, 2003: 94-95, cited in Temiz, 2004: 63-64). Due to the flexible labor market, there was a significant increase in the number of women employed, particularly in the 1980s and 1990s. The rise in women's employment is also attributed to the desire to create a more flexible labor force that can be laid off more efficiently and at lower costs. Young people entering the labor market at an early age, especially while continuing their education, have led to an increase in temporary and part-time employment. Similarly, to avoid unemployment and make a living, individuals accept precarious, unstable, and suboptimal working conditions in temporary and fixed-term jobs (Temiz, 2003: 64-65). In other words, poverty directly drives individuals into precarious employment types, and thus, the phenomenon of poverty provides a basis for the existence of precarious employment. Developments in the manufacturing industry have also resulted in reduced employment opportunities in this sector, increasing the potential for precarious employment (Magdoff & Magdoff, 2004: 22). Part-time and temporary employment types proposed as a solution to unemployment also pave the way for precarious employment, thus increasing the potential for employment in precarious jobs (Korpi & Levin, 2001: 128). Government policies, when implemented in practice, can also directly lead to precarious employment (Gorz, 2001: 114). Economic crises, partly due to government policies and partly due to global factors, also have negative consequences in the labor market, which pave the way for temporary employment.

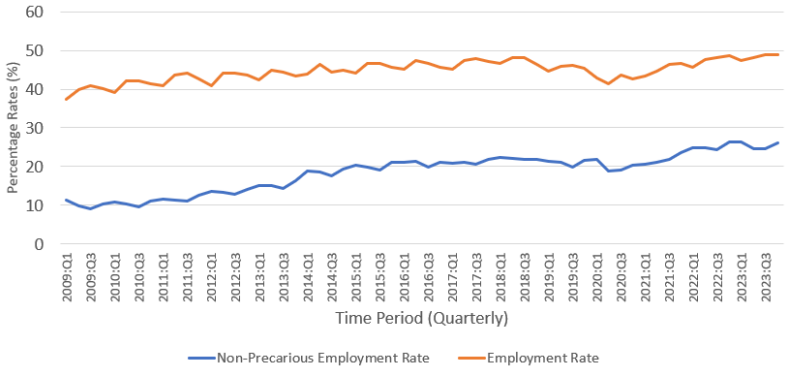
In Türkiye, labor force indicators are published by the Turkish Statistical Institute (TÜİK). TÜİK collects labor force data by international standards and calculates it using internationally recognised definitions. However, the COVID-19 pandemic has had unprecedented effects on the labor market, leading to anomalies in labor force and unemployment dynamics. Due to these anomalies, the official labor force indicators, traditionally calculated in Türkiye and some other countries, have become inadequate in accurately reflecting the picture of the labor markets. As a result, the Social Policy Implementation and Research Center (SPM) began calculating and publishing a new concept, termed "non-precarious employment," derived from the idea of precarious employment, which had limited use in existing literature as of September 2020. The concept of non-precarious employment refers to individuals working in non-agricultural jobs that are covered by social security and are employed on a full-time basis. Moreover, they calculate and publish the "non-precarious employment rate" by relating individuals in non-precarious employment to the non-institutional working-age population (SPM, 2020: 4). Accordingly, non-precarious employment and non-precarious employment rates are calculated as follows:

> Non-Precarious Employment = Total Employment - Employed in the Agricultural Sector - Informal Workers - Time-Related Underemployment

Non-Precarious Employment Rate = Non-Precarious Employment / Non-institutional Population Aged 15+

Figure 1 shows the trend of the employment rate and the non-precarious employment rate from 2009 to 2023.

Figure: 1
Proportional View of Employment / Non-Precarious Employment



Source: Created by the author using the necessary data obtained from TÜİK.

As seen in Figure 1, there is a significant difference between employment and non-precarious employment. While the employment rate fluctuates between 40% and 50%, non-precarious employment ranges between 20% and 30%. This considerable gap between non-precarious employment rates and overall employment rates is noteworthy.

3. The Concept and Importance of Broadly Defined Unemployment

TÜİK, considering the ILO's guidelines, defines the unemployed population as "all non-institutional working-age individuals who were not employed during the reference period but had used at least one active job-seeking method in the last four weeks and were available to start work within two weeks". Additionally, as stated by TÜİK, individuals "who have found a job to start within three months or have set up their own business but are waiting to complete various deficiencies to start working" are also considered unemployed (TÜİK, 2022: 4).

It was emphasised at the 19th International Conference of Labour Statisticians (ICLS), held by the ILO, that the current unemployment rate alone is insufficient for measuring the labour market, necessitating the use of alternative indicators. Consequently, in addition to basic labor force indicators, alternative labor force indicators were defined as follows: "time-related underemployment, "potential labor force," and "unemployment" (TÜİK, 2024). Time-related underemployment is defined as "individuals who are employed during the reference week but have worked less than 40 hours in their main job or other jobs, express

a desire to work more hours, and are available to start additional work if possible". On the other hand, potential labor force is defined as "working-age individuals who are neither employed nor unemployed during the reference week, including those who are looking for work but are not able to start work in a short period and those who are not looking for work but are willing to work and can start work in a short period" (TÜİK, 2022: 4).

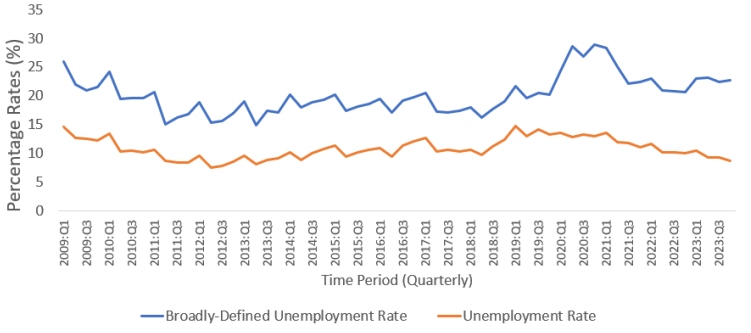
As part of the 19th ICLS, the ILO began publishing complementary labor force indicators, such as the combined rate of time-related underemployment and unemployment, the combined rate of unemployment and potential labor force, and the underutilised labor force. Unemployment, which is generally defined, can also be termed as narrowly defined unemployment. However, another type of unemployment is broadly defined unemployment, also known as the underutilised labor force, which includes the potential labor force and time-related underemployment in addition to narrowly defined unemployment. In this context, broadly defined unemployment considers and examines unemployment more comprehensively. Underutilised labor force/broadly defined unemployment is calculated as follows:

Underutilised labor force (Broadly Defined Unemployment) = Narrowly Defined Unemployment + Potential Labor Force + Time-Related Underemployment

The share of the unemployed population in the labor force is the unemployment rate, while the share of the underutilised labor force in the labor force and potential labor force is the underutilised labor force rate:

Underutilized labor force rate = [(Unemployed + Potential Labor Force + Time-Related Underemployment) / (Labor Force + Potential Labor Force)] * 100

Figure: 2
Proportional View of Unemployment / Broadly Defined Unemployment



Source: Created by the author using the necessary data obtained from TÜİK.

Examining Figure 2, it can be seen that there is a significant gap between the unemployment rate and broadly defined unemployment (underutilised labor force). This gap has widened remarkably, especially since 2020. The effect of the COVID-19 pandemic

shows that the standard unemployment rate does not accurately reflect the disruptions in the labor market, which become more apparent when considering broadly defined unemployment. While the unemployment rate has recently decreased, ranging from 8% to 9%, the broadly defined unemployment rate remains between 22% and 23%. This 14% difference between the two unemployment calculation methods is significant and warrants further investigation. This gap originates from the potential underutilisation of labor due to time-related factors. Policymakers are advised to address them in conjunction with policies aimed at reducing unemployment.

4. Literature

Due to its novelty and originality, the concept of non-precarious employment, derived from the limitedly used concept of precarious employment, has not been directly studied in the existing literature. However, studies on precarious employment, which can also be referred to as insecure or atypical employment, will play a guiding role in the literature.

Rodgers (1989) examines the rise of precarious employment in Western European countries, arguing that various types of precarious employment, including temporary, part-time, concealed, or illegal work, as well as home-based work and self-employment, have become widespread. Rodgers emphasises that these types of employment vary from country to country, generally suggesting that women typically hold part-time and home-based jobs, whereas temporary and unregistered jobs are often held by youth and immigrants. In this context, the importance of policies aimed at promoting qualified employment is emphasised.

Cranford et al. (2003) analyse the level of precarious employment in the Canadian labor market. They indicate that the most common types of precarious employment include part-time, fixed-term or contractual, seasonal, and temporary jobs, as well as those with a foreseeable end. They also highlight that precarious employment is significantly more prevalent among women in comparison to men and suggest that studies should explore the impact of education on precarious employment.

Temiz (2004) emphasises the importance, reasons, and problems associated with precarious employment in the labor market. He argues that precarious employment arises due to the flexibilisation of the labor market brought about by the capitalist system, global feminisation, the entry of partial and temporary jobs into the labor market, high unemployment rates, the decline of employment opportunities in the manufacturing sector, government policies, poverty, and economic crises. He emphasises that precarious employment can lead to both mental and physical problems for individuals and advocates for the implementation of policies to increase non-precarious, qualified employment.

Bosch (2004), in his study, examined precarious employment, which can be described as insecure employment, in Western European countries between 1988 and 2000. Besides highlighting multiple causes of precarious jobs, he emphasises that high unemployment elevates the level of competition in the labor market and reduces workers'

bargaining power. In this context, he argued that many workers are unable to make their preferred choices and are thus forced to accept involuntary part-time or temporary employment. As unemployment rises, the availability of standard employment types decreases, and non-standard, insecure, and precarious forms of employment become more widespread. The study highlights that these issues can be addressed through the regulation of labor markets.

Green and Livanos (2015) analysed how involuntary non-standard employment in England, before the crisis (Q2 2006-2008) and after (end of 2010), was explained by socio-economic and regional factors. In this context, the Heckman probit model was used to describe non-standard employment. The analysis results indicated that having dependent children has a positive influence on participation in non-standard jobs. Additionally, non-white individuals, young people, married individuals, those with higher education levels, lower-skilled individuals, and women, compared to others, are more likely to participate in non-standard employment. Thus, it is concluded that due to high unemployment, individuals unable to secure their desired jobs are compelled to accept non-standard and precarious employment to avoid unemployment.

Alkan (2021) examined precarious employment in Türkiye within the framework of changing employment patterns in the modern world. She argues that non-standard forms of employment have become increasingly widespread globally since the 1980s, resulting in the predominance of precarious employment. She further claims that the job losses and unemployment caused by the COVID-19 pandemic, which affected Türkiye, have transformed many previously full-time jobs and altered working patterns. Additionally, she notes that high unemployment and informal employment in Türkiye have led to increased precariousness in the labor market. She also notes that a significant portion of jobs in the agricultural sector, which is mainly informal, has contributed to the precariousness of the labor market in Türkiye, alongside insufficient social policies, low wages, high youth unemployment, and inadequate female employment.

Ferre (2021) examined the extent of precarious employment in Argentina between 2003 and 2017, as well as the characteristics of workers that influence their employment in insecure jobs. A logistic probit model was used in this context. The analysis concluded that being young and female was associated with higher rates of precarious employment. Furthermore, in terms of education level, those who completed primary and secondary education had a 57% lower possibility of being in insecure jobs than those with no education, while those with university education had an 87% lower likelihood. Married individuals were found to have a higher probability of insecure employment than single individuals, and foreign nationals were more likely to be in insecure jobs compared to locals. The results indicate that, in the face of unemployment, individuals are often compelled to take on insecure jobs.

Reviewing the literature, studies carried out by Rodgers (1989), Kalleberg (2000), Cranford et al. (2003), Temiz (2004), Hipp et al. (2015), and Kretsos and Livanos (2016)

indicate that precarious employment is common in part-time, temporary, or fixed-term jobs. It is also concluded that high unemployment leads individuals to accept insecure employment involuntarily and that high unemployment, in this sense, triggers precarious employment. The results suggest that, due to life concerns, individuals accept insecure jobs to avoid unemployment. Therefore, it is considered essential to address the relationship between decent, quality and qualified employment, an important concept in sustainable development plans, and broadly defined unemployment, which includes the potential labor force and time-related underemployment.

5. Data and Methodology

This section provides information about the variables used in the analysis and discusses the econometric method applied to analyse these variables.

5.1. Data Set

The present study analyses the relationship between non-precarious employment and broadly defined unemployment, also referred to as underutilised labour, for the period from Q1 2009 to Q4 2023. The selection of this time frame is motivated by the International Labour Organization's (ILO) 16th Conference, where the concept of underemployment was more clearly delineated by introducing two subcategories: "time-related underemployment" and "inadequate employment". Consequently, both the concepts of non-precarious employment and broadly defined unemployment have been calculated using the time-related underemployment concept, making these calculations applicable only from 2009 onwards. Furthermore, the use of a quarterly time frame for the variables in the present study is justified by the fact that the Turkish Statistical Institute (TÜİK) has been publishing data on the potential labor force and informal employment quarterly since 2021, rather than monthly. Given that the potential labor force concept is used to calculate broadly defined unemployment and the informal employment concept is used to calculate non-precarious employment, the analysis is conducted using quarterly data. These two factors constitute the main constraints of this study. Table 1 presents the definitions and data sources of the variables used.

Table: 1
Information on Variables

Variable	Definition	Source
NPE	Non-Precarious Employment [Total Employment - (Informal Employment + Time-Related Underemployment + Agricultural Employment)]	Calculated by the authors
Templ	Total Employment	TÜİK
Iempl	Informal Employment	TÜİK
Tund	Time-Related Underemployment	TÜİK
BDE	Broadly-Defined Unemployment (Narrow Unemployment + Potential Labor Force + Time-Related Underemployment)	Calculated by the authors
Nunem	Narrow Unemployment	TÜİK
Plab	Potential Labor Force	TÜİK

In Table 1, Templ represents total employment, Iempl represents informal employment, Tund represents time-related underemployment, Nunem represents narrowly defined unemployment, and Plab represents the potential labor force. The variables for total employment, informal employment, time-related underemployment, narrowly defined unemployment, and the possible labor force are obtained from TÜİK. In the analysis, NPE is the dependent variable, representing non-precarious employment, which is calculated by subtracting informal employment, time-related underemployment, and agricultural employment from total employment. BDE is the explanatory variable representing broadly defined unemployment, also known as the slack labor force. It is calculated by adding time-related underemployment and potential labor force to narrowly defined unemployment. The variables in the analysis were used in their logarithmic transformations.

5.2. Econometric Method

This section introduces the econometric method to be used in the study.

5.2.1. Fourier Kwiatkowski, Phillips, Schmidt, Shin (F-KPSS) Unit Root Test

Stationarity (or unit root) analysis of the series is essential in econometric analyses. Examining the stationarity of the series is necessary for the subsequent stages of the analysis. Although there are multiple tests for stationarity analysis, each has its advantages and disadvantages. Economic crises, political changes, and natural disasters can cause sudden shocks that change the mean, trend, or both the mean and trend of a time series. The presence of structural breaks explains these situations. Conducting stationarity analysis of the relevant series using traditional unit root tests under these conditions may lead to inconsistent results. The disadvantage of traditional unit root tests is that they do not account for structural breaks (Mert & Çağlar, 2023: 131).

Starting with the study by Perron (1989), unit root tests that consider structural breaks aim to capture sharp breaks using break dummies. Perron (1989) developed the Dickey-Fuller test, allowing for a single break, assuming the location of the break is known. The Perron (1989) test employs three distinct models: "break in the intercept (Model A), "break in the slope (Model B)," and "break in both the intercept and slope (Model C)" (Perron, 1989: 1363-1364). Subsequent studies adopt an endogenous approach, where the break date is estimated using the model, leading to the development of tests that allow for multiple breaks. Zivot and Andrews (1992) criticised the approach of incorporating the break into the model using a priori information in Perron's unit root test. They developed a unit root test where the break date is estimated endogenously from the model (Zivot & Andrews, 1992: 27). Lumsdaine and Papell (1997) and Lee and Strazicich (2003) developed unit root tests allowing for the estimation of two potential breaks endogenously within the model, building on Zivot's study. Leybourne, Newbold, and Vougas (1998) and Kapetanios (2003) contributed to the literature with unit root tests allowing for breaks with a more gradual structure determined endogenously. Narayan and Popp (2010) introduced a unit root test allowing for two breaks determined endogenously. Carrion-i-Silvestre et al. (2009)

introduced a unit root test that allows for endogenously determined breaks and permits up to five breaks. The criticism of these tests is that the breaks are predetermined. Applying a test allowing for two breaks to a series that contains only one break, or vice versa, can lead to erroneous results. Not only the number of breaks but also their nature is predetermined in these tests, which can result in incorrect outcomes (Yılancı, 2017: 56). Additionally, it is known that structural breaks are not only sharp and sudden but also gradual, and these tests are criticised for ignoring gradual breaks (Mert & Çağlar, 2023: 183-184).

To eliminate these problems and minimise errors, Enders and Lee (2012a) developed unit root tests based on the Lagrange Multiplier (LM) method, and Rodrigues and Taylor (2012) developed the DF-GLS method. Unit root tests incorporating flexible Fourier functions, as developed by Gallant (1981), were designed to model gradual breaks. According to the tests developed by Enders and Lee, the date of the breaks, the number of breaks, and the functional form are determined through the test process rather than a priori. Enders and Lee applied structural break unit root tests using Fourier terms instead of dummy variables.

Becker, Enders, and Lee (2006) addressed the issue of controlling for unknown form and number of breaks by incorporating Fourier functions into the traditional KPSS unit root test, thereby developing the Fourier KPSS unit root test. Fourier functions detect not only sharp and sudden breaks but also gradual and subtle ones, providing more consistent results (Becker et al., 2006: 381-382). The model for this test is as follows:

$$y_t = x_t^{'}\beta + z_t^{'}\gamma + r_t + \varepsilon_t \tag{1}$$

$$r_t = r_{t-1} + \mu_t \tag{2}$$

In equations given above, ε_t refers to the stationary error term, μ_t to the fixed variance error term, and Z_t refers to the vector 3 incorporating trigonometric terms.

$$Z_t = [\sin(2\pi kt / T), \cos(2\pi kt / T)]' \tag{3}$$

In equation (3), t refers to the long-term trend, T to the sample size, and k to the frequency value. The Fourier Model is represented as in equation (4), where $\alpha(t)$ is a function of the unknown number and form of breaks:

$$\alpha(t) = \alpha_k + \sum_{k=1}^{n} \alpha_k \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{n} b_k cos\left(\frac{2\pi kt}{T}\right);\ n < \frac{T}{2} \tag{4}$$

The equations that must be estimated to calculate the test statistic necessary to test the null hypothesis of stationarity ($H_0 = \sigma_{u=}^2 0$) are formulated as in equations (5) and (6).

$$y_{t=\alpha_0} + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) + \varepsilon_t \tag{5}$$

$$y_t = \alpha_0 + \beta_1 + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) \quad (6)$$

While equation (5) addresses the level stationarity, equation (6) addresses the trend stationarity. In equations (5) and (6), the optimal frequency is reported as the one that minimizes the sum of squared residuals using all frequency values from 1 to 5, with the maximum frequency set to 5 (Becker et al., 2006: 309).

The test statistic that needs to be calculated from these equations is formulated in equation (7).

$$\tau_\mu(\alpha); \tau_\tau(k) = \frac{1}{T^2}\frac{\sum_{t=1}^{T}\tilde{S}_t(k)^2}{\tilde{\sigma}^2} \quad (7)$$

In Equation (7), with $\tilde{S}_t(k)^2 = \sum_{j=1}^{t}\tilde{e}_j$, $\tilde{e}_j$ refers to the LS residuals obtained from Equations 5 and 6. $\tilde{\sigma}^2$obtained using the weights of the lag parameters *l* and w_j refers to the non-parametric estimation of long term variance and is formulised as in Equation 8:

$$\tilde{\sigma}^2 = \tilde{\gamma}_0 + 2\sum w_j\tilde{\gamma}_j \quad (8)$$

where, *j=1,2,..,l* refers to the weight series and *l* to the trimming lag parameter. Moreover, it also indicates the j^{th} autocovariance of the residuals obtained from equation (5) or (6).

The test statistic in equation (7) will lead to the rejection of the null hypothesis if it exceeds the critical value tabularised by Becker et al. (2006), indicating the presence of a unit root in the series.

Furthermore, to determine whether the sine and cosine terms added to the model for the data generation process are necessary for the stationarity test, the F-statistic is calculated. The relevant F-statistic is computed as shown in equation (9).

$$F_\mu(k) = \frac{(SSR_0 - SSR_1)/q}{SSR_1(k)/(T-k)} \quad (9)$$

In Equation 9, the sum of squared residuals of the regression without trigonometric terms is denoted as SSR_0, whereas the sum of squared residuals of the regression with trigonometric terms is denoted as SSR_1. Here, k represents a specific frequency. If the calculated F-statistic is significant and exceeds the critical F-values provided by Becker et al. (2006), it suggests that the F-statistic is substantial. Consequently, it is considered appropriate to use the KPSS test with trigonometric terms (FKPSS). Conversely, if the calculated F-statistic is less than the critical F-values, then it is considered appropriate to use the KPSS test without trigonometric terms for the stationarity analysis.

5.2.2. Fourier Shin Cointegration Test

The concept of cointegration was first introduced by Engle and Granger (1987), who developed the Engle-Granger cointegration test, which has become a standard in the literature. Traditional cointegration tests have been criticised for not accounting for structural breaks, a limitation similar to that of conventional unit root tests. Tests considering structural breaks have been developed, including Gregory and Hansen (1996) for a single break, Hatemi-J (2008) for two breaks, and Maki (2012) for up to five breaks. In these tests, breaks are incorporated into the model using dummy variables, a similar approach to that employed in structural break tests. However, this condition applies only to sudden and sharp breaks, potentially overlooking gradual and smooth breaks. Moreover, the number and form of structural changes are pre-determined in these tests, which has been a point of criticism.

In this context, cointegration tests incorporating smooth breaks have been introduced into the literature, one of which is the Fourier Shin (FSHIN) cointegration test by Tsong et al. (2016). This test extends the Shin cointegration test by adding Fourier terms. Unlike other tests, the null hypothesis in this test is the presence of a cointegration relationship, not its absence. In this regard, it can be considered an adaptation of the Fourier KPSS unit root test for cointegration (Tsong et al., 2016: 1087).

The data generation process for the FSHIN cointegration test introduced by Tsong et al. (2016) is as follows:

$$y_t = d_t + x_t'\beta + \eta_{t,}\ , \text{t=1,2…,T} \tag{10}$$

In equation (10), $\eta_t = \gamma_t + \upsilon_{1t}, \gamma_t = \gamma_{t-1} + \mu_t$ and $x_t = x_{t-1} + \upsilon_{2t}$. Moreover, the error term μ_t is an independently and identically distributed error term with a mean of 0 and a variance of σ_u^2, whereas γ_t represents a random walk process with a mean of 0. Since the scalar υ_{1t} and the p-dimensional vector υ_{2t} are stationary, y_t and x_t are first-difference stationary processes.

In addition, the term d_t in Equation (10) can be represented in two ways depending on whether the model includes only a constant (intercept) term or both a constant term and a trend.

$$d_t = \delta_0 + f_t \tag{11}$$

$$d_t = \delta_0 + \delta_1 t + f_t \tag{12}$$

f_t in Equations (11) and (12) is Fourier function and expressed as follows:

$$f_t = \alpha_k sin\left(\frac{2\pi kt}{T}\right) + \beta_k cos\left(\frac{2\pi kt}{T}\right) \tag{13}$$

In equation (13), the Fourier function represents the frequency value k, the trend t, and the number of observations T. The F-Shin cointegration test introduced by Tsong (2016)

is an extension of the FKPSS stationarity test. When the variable x_t on the right side of the data-generating process in equation (10) for the F-Shin cointegration test is absent, it coincides with the data-generating process in equation (1) for the FKPSS test. Conversely, when $\alpha_k = \beta_k = 0$, the data-generating process for the Shin cointegration test can be obtained. Additionally, in the data-generating process for the FKPSS test, eliminating x_t from the right side of the equation and setting $\alpha_k = \beta_k = 0$ yields the data-generating process for the KPSS stationarity test. In this regard, the F-Shin test is an extension of the Shin test with Fourier terms and is also an adaptation of the FKPSS test for cointegration (Yılancı, 2017: 59).

In the F-Shin cointegration test, the null hypothesis indicating the presence of cointegration with structural breaks and the alternative hypothesis indicating the absence of cointegration are as follows:

$H_0 = \sigma_u^2 = 0$

$H_1 = \sigma_u^2 > 0$

To obtain the test statistic necessary to test the basic hypothesis of cointegration against the alternative hypothesis, the y_t series can be re-obtained based on equations (10) and (13):

$$y_t = \delta_0 + \alpha_k sin\left(\frac{2\pi kt}{T}\right) + \beta_k cos\left(\frac{2\pi kt}{T}\right) + x_t'\beta + \upsilon_{1t} \quad (14)$$

Based on equation (14), the F-Shin test statistic value can be calculated as follows:

$$CI_f^m = T^{-2}\widehat{\omega}_1^{-2}\sum_{t=1}^{T} S_t^2 \quad (15)$$

In equation (15), $S_t = \sum_{t=1}^{T} \upsilon_{1t}$ represents the partial sum of the OLS residuals obtained from equation (14), and $\widehat{\omega}_1^2$ represents the consistent estimator of the long-term variance of υ_{1t}.

Tsong et al. (2016) followed the process suggested by Becker et al. (2006) for selecting the appropriate frequency value k. According to this process, ($k_{max} = 3$) k= 1, 2, 3 values (with a maximum value of k being 3) are substituted into equation (14). The frequency value k* that yields the minimum sum of squared residuals is determined (Tsong et al., 2016: 1090-1091). If the calculated CI_f^m statistic value exceeds the relevant critical values provided in Tsong et al. (2016), the null hypothesis is rejected, indicating no cointegration with structural breaks. If the calculated statistic value is less than the relevant critical value, the null hypothesis cannot be rejected, indicating the presence of cointegration with structural breaks.

In addition, Tsong et al. (2016) examined the conditions under which the Fourier roots are significant and whether they should be included in the cointegration process.

Following Becker et al. (2006), they calculated the F statistic. The relevant F statistic value is as follows:

$$F^m(k^*) = max_{k\epsilon(1,2,3)}\ F^m(k)$$

$$F^m(k) = \frac{(SSE_0^m - SSE_1^m(k))/2}{\frac{SSE_1^m(k)}{(T-q)}} \quad (16)$$

In equation (16), SSE_0^m represents the sum of squared residuals of the regression without trigonometric terms, $SSE_1^m(k)$ represents the sum of squared residuals of the regression with trigonometric terms, and q represents the number of parameters in the regression equation with trigonometric terms. If the F-statistic value calculated is greater than the relevant table critical values, the null hypothesis is rejected, indicating that Fourier components should be included in the model.

6. Results

Whether the variables contain unit roots was first examined using traditional unit root tests, including the Augmented Dickey-Fuller (ADF) and KPSS tests. Table 2 presents the unit root/stationarity test results obtained using the ADF and KPSS tests.

Table: 2
Traditional Unit Root-Stationarity Test Results

Model	Variables	Method	Test Statistic	Critical Values		
				1%	5%	10%
Constant	lnNPE	ADF	-1.0599	-3.5461	-2.9117	-2.5935
		KPSS	0.8754 (6)	0.7390	0.4630	0.3470
	ΔlnNPE	ADF	-6.6992	-3.5483	-2.9126	-2.5940
		KPSS	0.1907 (2)	0.7390	0.4630	0.3470
	lnBDE	ADF	-0.7795	-3.5461	-2.9117	-2.5935
		KPSS	0.7723 (6)	0.7390	0.4630	0.3470
	ΔlnBDE	ADF	-8.5612	-3.5483	-2.9126	-2.5940
		KPSS	0.1495 (2)	0.7390	0.4630	0.3470
Constant and Trend	lnNPE	ADF	-1.0617	-4.1213	-3.4878	-3.1723
		KPSS	0.2054 (6)	0.2160	0.1460	0.1190
	ΔlnNPE	ADF	-6.8427	-4.1243	-3.4892	-3.1731
		KPSS	0.1054 (1)	0.2160	0.1460	0.1190
	lnBDE	ADF	-2.8936	-4.1213	-3.4878	-3.1723
		KPSS	0.1222 (5)	0.2160	0.1460	0.1190
	ΔlnBDE	ADF	-8.6011	-4.1243	-3.4892	-3.1731
		KPSS	0.0753 (3)	0.2160	0.1460	0.1190

Note: The term "ln" indicates that the variables have undergone a logarithmic transformation. The term "Δ" denotes that the first difference of the variables has been taken. The values in parentheses represent the bandwidths obtained using the Newey-West method.

As shown in Table 2, according to the ADF unit root test results for the models with constant and constant and trend, the variables lnNPE and lnBDE exhibit unit roots at their levels. Similarly, according to the KPSS unit root test results for the models with constant and constant and trend, it is observed that the variables lnNPE and lnBDE contain unit roots at their levels. According to the unit root test results applied to the differenced series, the variables are found to be stationary. In this case, considering the traditional unit root tests, it is found that the variables lnNPE and lnBDE are stationary at their first difference, i.e., I(1).

After examining stationarity using traditional unit root tests, the Fourier KPSS unit root/stationarity test was also employed for further analysis. Table 3 presents the Fourier KPSS unit root/stationarity test results for the models with a constant and those with a continuous and trend.

Table: 3
Fourier KPSS Stationarity Test Results

Model	Variable	MinRSS	k	FKPSS	F-Statistic	Critical Values		
						%10	%5	%1
Constant	**lnNPE**	3.6501	1	0.4004 (6)	34.4759*	0.1318	0.1720	0.2699
	ΔlnNPE	0.0875	1	0.1395 (4)	2.2920	0.1318	0.1720	0.2699
	lnBDE	0.9136	1	0.2445 (5)	69.2069*	0.1318	0.1720	0.2699
	ΔlnBDE	0.2959	3	0.2534 (9)	1.8447	0.3393	0.4480	0.7182
Constant and Trend	**lnNPE**	0.1781	1	0.0613 (5)	111.8835*	0.0471	0.0546	0.0716
	ΔlnNPE	0.0835	1	0.0528 (6)	3.4172	0.0471	0.0546	0.0716
	lnBDE	0.5520	3	0.1758 (5)	19.5158*	0.1141	0.1423	0.2103
	ΔlnBDE	0.2913	3	0.1329(12)	1.8937	0.1141	0.1423	0.2103

Note: For the constant model, the critical values for the F-statistic at the 10%, 5%, and 1% significance levels are 4.133, 4.929, and 6.730, respectively. For the model with both constant and trend, the critical values for the F-statistic at the 10%, 5%, and 1% significance levels are 4.162, 4.972, and 6.873, respectively. An asterisk (*) indicates significance at the 1% level for the F-statistic values. The values in parentheses represent the bandwidth determined using the Bartlett-Kernel method. The term "ln" indicates that the variables have undergone a logarithmic transformation. The symbol "Δ" denotes the first differences of the variables. MinRSS stands for the minimum residual sum of squares, k represents the reference value, and FKPSS denotes the Fourier KPSS test statistic.

As shown in Table 3, for both models, the F-statistic values of the lnNPE and lnBDE variables exceed the F-table critical values, indicating that they are statistically significant. This means that the trigonometric terms are substantial, suggesting that the stationarity of the variables can be determined using the Fourier KPSS unit root test. It can be seen that the level values of the lnNPE and lnBDE series exceed the table critical values for both models, and thus the null hypothesis can be rejected, indicating that the series contain unit roots at their levels. Considering the unit root test results applied to the differenced series, it is observed that the test statistic values are smaller than the table's critical values; in this case, the null hypothesis can be accepted, indicating that the variables are stationary in their first difference, i.e., [1].

To examine the long-term relationship of the series, which were determined to be stationary at their first difference, Shin and Fourier-Shin cointegration tests were used. Table 4 shows the Shin and Fourier-Shin cointegration test results.

Table: 4
Shin and Fourier-Shin Cointegration Test Results

Model	MinSSR	k	F-Shin Test	Critical Values			Shin Test	F-Statistic
				10%	5%	1%		
lnNPE=*f*(lnBDE)	0.7300	1	0.1603* (4)	0.095	0.124	0.198	0.3107 (5)	23.874*
lnBDE=*f*(lnNPE)	0.4578	1	0.0530* (5)	0.095	0.124	0.198	0.2416 (5)	12.815*

Note: The critical values of the F-statistic table for the 10%, 5%, and 1% significance levels are 3.352, 4.066, and 5.774, respectively. The asterisk "" denotes significance at the 1% level. The notation "ln" indicates that the variables have undergone a logarithmic transformation. MinSSR represents the minimum residual sum of squares, k is the reference value, and F-Shin denotes the Fourier-Shin Cointegration test statistic. The values in parentheses indicate the bandwidth determined using the Bartlett-Kernel method.*

As seen in Table 4, the F-statistic value is statistically significant at the 1% significance level. This indicates the significance of the trigonometric terms, demonstrating

that the cointegration relationship can be examined using the Fourier-Shin test. If the F-statistic value was statistically insignificant and the Fourier roots were found to be negligible, the Shin test would be used instead of the Fourier-Shin test. The Fourier Shin cointegration test statistic values are smaller than the table critical values, indicating that the null hypothesis cannot be rejected and the variables have a cointegration relationship. This suggests a long-term relationship between non-precarious employment and broadly defined unemployment.

Given the Fourier-Shin test result, there is evidence of a long-term relationship between the variables, necessitating the examination of long-term coefficients. Table 5 presents the long-term coefficients obtained using FMOLS, DOLS, and CCR tests.

Table: 5
Long-Term Coefficient Estimation by FMOLS, DOLS, and CCR Tests

Variables	Coefficient	Standard Error	T-statistic	Probability Value
FMOLS Results				
lnBDE	-0.6732	0.1716	-3.9234	0.0002*
C	14.3780	1.4456	9.9458	0.0000*
Sin	-0.0714	0.0315	-2.2649	0.0276**
Cos	0.0606	0.0293	2.0692	0.0433**
DOLS Results				
lnBDE	-0.6941	0.1944	-3.5714	0.0008*
C	14.5393	1.6341	8.8970	0.0000*
Sin	-0.0645	0.0305	-2.1108	0.0399**
Cos	0.0691	0.0300	2.2979	0.0259**
CCR Results				
lnBDE	-0.6649	0.1607	-4.1374	0.0001*
C	14.3098	1.3567	10.5476	0.0000*
Sin	-0.0716	0.0316	-2.2683	0.0273**
Cos	0.0613	0.0294	2.0847	0.0418**

Note: "" and "**" indicate significance at the 1% and 5% levels, respectively. The term "ln" denotes that the variables have undergone a logarithmic transformation.*

As seen in Table 5, the trigonometric roots (sin and cos) are significant for the FMOLS, DOLS, and CCR tests. This validates the use of Fourier roots in the analysis and supports the consistency of the analysis. Given the FMOLS, DOLS, and CCR estimator results, all results are statistically significant. It is concluded that a 1% increase in broadly defined unemployment decreases non-precarious employment by approximately 0.67% according to FMOLS findings, by approximately 0.69% according to DOLS findings, and by approximately 0.66% according to CCR findings. Therefore, it is concluded that broadly defined unemployment has a long-term impact on non-precarious employment, with a change ranging from 0.66% to 0.69%, and this change is in the opposite direction.

7. Conclusion and Suggestions

In this study, the relationship between non-precarious employment and broadly defined unemployment in Türkiye was analysed by considering the "decent work" policy that is frequently emphasised in sustainable development plans. A time series analysis was conducted using quarterly data from the period between 2009 and 2023. For this purpose, tests incorporating Fourier functions, which account for smooth structural breaks, were

employed. Initially, the stationarity of the series was tested using the KPSS and F-KPSS tests. The long-term relationship of the series, which were determined to be stationary at their first differences, was analysed using the F-Shin cointegration test. According to the results of the F-Shin cointegration test, it is concluded that the variables move together in the long term, indicating they are cointegrated. Considering the cointegration results, coefficient estimates for the variables were made using FMOLS, DOLS, and CCR tests. Given the coefficient estimation results, a 1% increase in broadly defined unemployment reduces non-precarious employment by approximately 0.67% based on FMOLS, approximately 0.69% based on DOLS, and approximately 0.66% based on CCR results. It has been established that broadly defined unemployment has a negative long-term impact on non-precarious employment. This result aligns with the results reported by Rodgers (1989), Temiz (2004), Bosch (2004), Green and Livanos (2015), and Işıl Alkan (2021), which indicate that unemployment contributes to the problem of precarious employment.

Within the framework of the "decent work policy," which plays a crucial role in sustainable development plans and complements efforts to reduce poverty, quality and skilled employment hold significant importance. In this context, it is recommended that policymakers implement policies aimed at reducing and controlling informal employment, an element of non-precarious employment. Moreover, policies should be developed to regulate "time-related underemployment" (part-time, half-time, etc.) within both non-precarious employment and broadly defined unemployment frameworks, aiming to reduce the elements of low-quality and unskilled employment. Policies should also aim to reduce the potential labor force, which constitutes a significant part of broadly defined unemployment, and attract it to quality, skilled employment. As seen in the literature, it is recommended that policies be developed to promote the transition of women and youth, who constitute a significant portion of precarious employment, to non-precarious, quality employment. It is recommended to conduct awareness-raising activities to enhance job search skills and adapt to the working environment. The reasons for brain drain from our country abroad should be analysed, and efforts should be made to retain skilled labor in Türkiye. Overall, it is recommended to implement policies that increase the number of individuals employed in high-quality employment, which indeed bears the economic burden. Researchers are also advised to conduct both time series and panel studies and analyses on factors affecting skilled labor, which is crucial for implementing decent work policies.

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