



JATSS, 2025; 7(3), 282-304

First Submission: 25.06.2025

Revised Submission After Review: 16.09.2025

Accepted For Publication: 28.09.2025

Available Online Since: 30.09.2025

Research Article

**Women's Power, Equality's Balance? The Relationship Between Female
Employment and Income Distribution in Mediterranean Countries**

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Abstract

Introduction: This study examines the impact of female employment on income inequality in Mediterranean countries such as Turkey, Greece, Italy, and Spain, using annual panel data covering the period 1991–2022. The primary focus of the research is to determine whether female employment has a mitigating effect on income inequality in the selected countries.

Method: The Gini index is utilized to represent income inequality, with the female employment rate acting as the central explanatory factor. Inflation, HDI and GDPPC are included as control variables. The analysis utilizes a Panel ARDL model, which accommodates variables with mixed levels of stationarity.

Results or Findings: The findings indicate that women's employment has a statistically significant and negative impact on income inequality in the long run. Conversely, inflation increases income inequality, while economic growth decreases it. In the short run, increases in women's employment have a significant impact on reducing income inequality. Panel Granger causality analysis reveals a bidirectional causal relationship between women's employment and income inequality.

Discussion or Conclusion: This result highlights the interplay between women's economic participation and income distribution, emphasizing that female employment is a key instrument for achieving social and economic justice.

Keywords: women's employment, income inequality, inflation, economic growth

JEL Codes: C33, E31, J70

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JATSS, 2025; 7(3), 282-304

İlk Başvuru: 25.06.2025

Düzeltilmiş Makalenin Alınışı: 16.09.2025

Yayın İçin Kabul Tarihi: 28.09.2025

Online Yayın Tarihi: 30.09.2025

Araştırma Makalesi

**Kadının Gücü, Eşitsizliğin Dengesi mi? Akdeniz Ülkelerinde Kadın İstihdamı ve
Gelir Dağılımı İlişkisi**

Süleyman Gürbüz^a

Öz

Giriş: Bu çalışma, Türkiye, Yunanistan, İtalya ve İspanya gibi Akdeniz ülkelerinde kadın istihdamının gelir eşitsizliği üzerindeki etkisini 1991–2022 dönemine ait yıllık panel verilerle incelemektedir. Çalışmanın odak noktası kadın istihdamının seçili ülkelerde gelir adaletsizliğini azaltıcı etkisinin olup olmadığıdır.

Yöntem: Gelir dağılımını temsilen Gini katsayısı, temel açıklayıcı değişken olarak ise kadın istihdam oranı kullanılmış; kontrol değişkenleri olarak enflasyon, HDI ve kişi başına düşen GSYH modele dahil edilmiştir. Ekonometrik analizde Panel ARDL yöntemi tercih edilmiştir.

Sonuçlar ya da Bulgular: Bulgulara göre, uzun vadede kadın istihdamının gelir eşitsizliğine istatistiksel olarak anlamlı ve negatif bir etkisi bulunmaktadır. Buna karşılık, enflasyon gelir eşitsizliğini artırıcı, ekonomik büyüme ise azaltıcı bir rol oynamaktadır. Kısa vadede ise kadın istihdamında meydana gelen artışların gelir eşitsizliğini azaltma yönünde anlamlı etkileri gözlemlenmiştir. Panel Granger nedensellik analizi ise kadın istihdamı ile gelir eşitsizliği değişkenlerinde çift yönlü nedensellik ilişkisi bulunduğunu ortaya koymuştur.

Tartışma ya da Yapılan Çıkarımlar: Bu sonuç, kadınların ekonomik hayata katılımı ile gelir dağılımı arasındaki karşılıklı etkileşimi göstermekte ve kadın istihdamının sosyal ve ekonomik adaletin sağlanmasında önemli bir araç olduğunu vurgulamaktadır.

Anahtar Kelimeler: kadın istihdamı, gelir adaletsizliği, enflasyon, ekonomik büyüme

JEL Kodlar: C33, E31, J70

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Introduction

In today's world, growing income inequality poses a key challenge to socioeconomic stability in countries regardless of their development status. Beyond undermining equitable access to resources and opportunities, it also jeopardizes the sustainability of economic growth and threatens social cohesion and stability (Piketty, 2014). As such, identifying the root causes of income disparities and formulating effective policy tools to alleviate them has become a critical area of concern for policymakers worldwide. Among the many factors shaping income distribution, the composition of employment, with an emphasis on women's labor market engagement, has received heightened attention in recent studies. Limited participation of women in the formal economy constrains human development and macroeconomic performance; projections indicate that this shortfall will translate into an annual global GDP loss of roughly USD 28 trillion by 2025. Across the literature, there is broad agreement that expanding women's economic engagement yields substantial societal dividends, including poverty reduction, stronger innovative capacity, wider consumer choice, and more durable environmental sustainability (Asongu & Odhiambo, 2020).

There are many factors affecting women's employment rates. The most fundamental factors that prevent women from entering the workforce include: traditional social structure, societal values, gender-based division of labor within the family, the role of motherhood, low female employment demand due to fertility, inadequate education levels, structural problems in the economy, and legal regulations (Karabıyık, 2012). Differences in labour-market access by gender translate into parallel differences in employment outcomes. In affluent countries, where most workers are formal paid employees, women tend to earn less than comparable men, face sectoral and occupational segregation, and remain scarce in top-remunerated positions. In developing economies, where self-employment is common, women are disproportionately unpaid family workers and are less often employers or own-account workers. Thus, indicators such as gender wage gaps and promotion pathways in salaried jobs capture the experience of only a limited share of women. A comprehensive assessment of women's labour-market status calls for more inclusive employment measures (Bue et al., 2022).

There are multiple dimensions through which the relationship between women's workforce participation and income inequality can be analyzed. By contributing to household earnings, higher female employment rates can play a role in narrowing income disparities. Moreover, the inclusion of women in economic life may help foster a more inclusive and balanced economic order (Seguino, 2000). However, the strength and direction of this influence are not uniform across contexts; they are often mediated by a country's developmental stage, institutional arrangements, prevailing gender norms, and socio-economic policy frameworks. When examining traditional social structures, the primary roles assigned to women are housework and motherhood. Domestic labor can be evaluated in two fundamental dimensions within the capitalist division of labor. First, it functions as a form of production that provides surplus value and unpaid work to support production outside the home; second, it functions as a mechanism that enables individuals to participate in the capitalist production process by reproducing labor power and transferring values to them. In this context, the unpaid nature of domestic labor serves the productive structure of the capitalist economy. Consequently, gender-based divisions of labor within and outside the household leave women more vulnerable to poverty than men, despite living in the same household and family (Yenilmez, 2015). Gonzales et al. (2015) maintain that gender inequality propagates income inequality through multiple mechanisms. First, pay differentials between women and men directly widen overall income dispersion. In addition, larger gender gaps in labour-force participation translate into earnings disparities, thereby generating and intensifying income inequality.

In Southern European nations like Turkey, Greece, Italy, and Spain, low rates of women's participation in the labor market persist alongside significant income inequality. Referring to data published by the World Bank in 2025, the global average female employment rate stood at 45.69%, while the European Union averaged 48.24%. In contrast, female employment rates in the aforementioned countries were notably lower: 30.30% in Turkey, 37.14% in Greece, 36.27% in Italy, and 44.80% in Spain. These figures highlight a consistent lag in female participation compared to global and EU benchmarks (World Bank, 2025). When looking at the ranking of gender-based employment rate differences based on these rates and evaluated within the scope of the 27 EU member countries and Turkey, Turkey ranks 28th, followed by Greece and Italy in 27th and 26th places, respectively, and Spain in 20th place. The gender employment gap in these four countries remains below the EU average (Yanatma, 2024). At the same time, these countries exhibit considerable income inequality, with Gini coefficients of 0.41 in Turkey, 0.33 in Greece, 0.35 in Italy, and 0.34 in Spain—all exceeding the OECD average. When the 27 EU member states and Türkiye are ranked according to the Gini coefficient, Greece ranks 17th, Spain 20th, Italy 24th and Türkiye 28th (Eurostat, 2025). When the 27 EU member countries and Türkiye are ranked in terms of GDP per capita, Italy ranks 12th, Spain 14th, Greece 21st and Türkiye 28th (Statista, 2025). These disparities have evolved over decades shaped by economic crises, structural reforms, and demographic shifts. Thus, evaluating the nexus between female employment and income inequality within these historical and institutional contexts is essential.

According to the World Bank Report (2012), gender equality strengthens economic efficiency and supports sustainable development through three main channels. First, it requires the removal of barriers limiting women's equal access to education, economic opportunities, and productive resources. Second, improvements in women's absolute and relative status generate positive spillover effects, particularly for child and family welfare. Finally, promoting women's participation in social and political spheres fosters more inclusive institutions and policy choices, thereby contributing to a more equitable development trajectory (World Bank, 2012).

Although relatively limited in number, empirical studies exploring the link between employment of women and income inequality are growing. Galor and Weil (1996) suggest that increased female labour participation can alleviate inequality by boosting overall household income. Conversely, Seguino (2000) cautions that the concentration of women in low-paying jobs may weaken this positive effect. Theoretical frameworks in macro studies posit that gender inequality affects growth via constrained skills formation and intergenerational spillovers. Excluding women from education narrows the skilled talent pipeline; conversely, greater female schooling yields externalities such as reduced fertility and better child human capital. Employment gaps operate through comparable pathways, albeit with complications arising from reverse causality. On balance, higher female labour force engagement enlarges the skilled labour pool and strengthens intra-household bargaining leverage for women, fostering gains in children's human capital (Costa et al., 2009). OECD (2017) findings also support a generally inverse relationship between women's workforce participation and inequality, although country-specific political and economic factors often mediate this connection.

This research aims to empirically assess the effect of female employment on income inequality using panel data covering the years 1991 to 2022 for Turkey, Greece, Italy, and Spain. In this study, income inequality is proxied by the Gini coefficient, which serves as the dependent variable, with the female employment rate serving as the key explanatory factor. Inflation and GDP per capita are incorporated as control variables to capture broader macroeconomic dynamics that may influence income distribution.

The model employed in this analysis positions the Gini index as a proxy for income inequality, and the female employment rate as the central variable of interest. Inflation and GDP per capita are also included as macroeconomic controls given their potential impact on distributional outcomes. The inflation-inequality nexus remains contested; while some studies argue that inflation disproportionately burdens lower-income households and worsens inequality (Bulír & Gulde, 1995), others contend that it can, under certain circumstances, lead to redistributive effects. Similarly, the relationship between GDP per capita and inequality is often discussed within the framework of the Kuznets curve hypothesis (Kuznets, 1955), which posits a non-linear relationship over the course of development. Galor and Weil (1996) posit a feedback mechanism linking female labour-force engagement to development: as participation lifts household revenues, the resulting increase in savings augments capital intensity, thereby promoting economic growth. Kim and Lin (2023) argues that low inflation rates can encourage economic growth and thus can reduce income injustice with the opposite U-shaped Kuznets curve mechanism. However, unexpected high inflation rates will be adversely affected because people with low income levels cannot make portfolio diversification, and that the rich section can be protected from the negative effects of inflation by making a portfolio diversification. Therefore, high inflation rates may lead to an increase in income injustice.

The distinctive contribution of this study lies in its comparative, long-term panel analysis of four Mediterranean countries, encompassing significant historical periods such as the post-Cold War era, the acceleration of globalization, the 2008 global financial crisis, and the socio-economic disruptions brought about by the COVID-19 pandemic. In doing so, it offers both theoretical insights and policy-oriented findings regarding the influence of women's labor force participation on income distribution.

Ultimately, integrating women into the labor force is crucial not only for gender equality but also for advancing a more equitable distribution of income and enhancing overall economic inclusion. Through a cross-national and longitudinal analysis of female employment's influence on income inequality, this research seeks to enrich academic understanding and guide informed policymaking. The structure of the paper is as follows: Section 1 introduces the theoretical background and the country context; Section 2 reviews the relevant literature; Section 3 details the data and methodology employed; and Section 4 presents the empirical findings alongside policy recommendations.

Literature Review

In recent years, academic interest in issues such as income inequality, poverty, and gender-based discrimination has grown steadily, with specific reference to the Sustainable Development Goals. This study situates itself within this growing body of research, aiming to evaluate the evolving relationship between women's employment and income inequality. In the following section, the relevant literature is reviewed, with a focus on both the direct association between the key variables and broader macroeconomic dynamics that may influence this relationship.

The first part of the literature review concentrates on empirical and theoretical studies that explore the nexus between women's employment and income distribution. A widely shared conclusion across much of this literature is that greater female participation in the workforce may contribute to a more equitable income distribution through its positive effect on household income levels (Gronau, 1982; Western et al., 2008). For instance, Winegarden (1987), in an analysis involving 50 countries, found that while an initial increase in female employment might lead to greater income inequality in the short term, further increases tend to exert a

balancing effect over time. Similarly, Gornick (2004) found that persistent wage disparities between men and women contribute to intra-household income inequality, even in high-income countries.

Ding et al. (2009) examined the implications of labour market reforms in China by comparing household survey data across two reform periods: 1988–1995 and 1995–2002. Their results indicate that retrenchments in the public sector during the late 1990s disproportionately affected women in low-income households, leading to a widening of income inequality. Costa et al. (2009) examine how gender disparities in the labour market relate to key economic outcomes (income growth, poverty, and inequality) using microsimulations for eight Latin American economies. The study operationalizes gender inequality along four dimensions: gaps in labour-force participation, differences in occupational status, wage discrimination, and disparities in observable characteristics. The results underscore the importance of gender equality, especially broader female access to the labour market, in reducing poverty and inequality. In another cross-country analysis, Harkness (2010) studied 17 OECD countries and reported a generally negative correlation between female employment and income inequality. While she acknowledges disparities within the female workforce itself—particularly between high- and low-skilled workers—the overall trend suggested a mitigating effect of female labour participation on inequality. In a cross-national analysis of 16 Western countries, Kollmeyer (2013) investigates the distributional consequences of recent changes in family formation and female labour-market participation. The central hypothesis posits countervailing effects: increases in women’s employment reduce inequality, while growth in single-mother families elevates it. Estimates from two-way random-effects models substantiate this pattern, with findings resilient to controls for institutional features of labour markets, social policy regimes, and other structural characteristics.

Grotti and Scherer (2016) supported this finding in their study covering Denmark, Germany, Italy, and the United Kingdom, highlighting the role of women’s employment in reducing inequality during the 1980s and 2000s. In Japan, Sudo (2017) showed that the initial rise in female employment temporarily increased income disparities, but over the longer term, helped to narrow the gap. Efobi et al. (2018) contend that expanding women’s participation in the formal economy advances socio-economic outcomes on multiple fronts—most notably reducing poverty, driving structural transformation in labor markets, and enhancing women’s welfare. Filandri and Struffolino (2019), through their study of 31 European countries, reached a similar conclusion—employed women play a significant role in alleviating inequality. Meanwhile, Asongu and Odhiambo (2019), focusing on 42 sub-Saharan African nations, demonstrated that worsening income inequality can, in turn, suppress female labour participation, suggesting a bidirectional relationship. They used both the Gini index and the Palma ratio to gauge inequality levels, offering a nuanced perspective on the issue. Segato (2021) examined the impact of female employment on individual and household income distribution for Italy. In Italy, despite regional differences, female employment continued to increase, with overall equalizing effects on household income distribution. In terms of socio-demographic changes, the decline in male-breadwinner households and the rise in single households contributed to the reduction of household income inequality. In the Italian case, part-time work may contribute to the reduction of inequality only in female-breadwinner households. Alfani et al. (2024), developed, developing and underdeveloped countries in groups of women's employment rate of participation in the relationship with income distribution. The results of the study show the validity of the opposite U -shaped curve, especially in developing countries. In other words, income injustice is negatively affected by this situation when women's employment rate increases to a certain point in developing countries.

Several scholars have expanded the analysis by linking gender inequality in employment to broader developmental outcomes. Thomas (1997), for example, showed that when women have greater control over household income, spending patterns shift significantly—more resources are allocated to health and nutrition, leading to improvements in child development indicators such as height and weight. These shifts in household dynamics are likely to produce long-term gains in human capital, ultimately contributing to sustainable economic growth.

Seguino (2000a, 2000b) emphasized that wage disparities between men and women not only perpetuate inequality but also limit a country's economic performance, especially under export-driven growth models where underutilized female labour represents a missed opportunity. Mammen and Paxson (2000) observed that in countries such as India and Thailand, increasing female employment was associated with falling fertility rates and narrowing educational gaps between genders. In contrast, Cavalcanti and Tavares (2007) argued that limited participation of women in the workforce contributes to higher fertility, which may obstruct long-term economic development. Klasen and Lamanna (2009), using a broad dataset spanning 1960 to 2000, concluded that gender gaps in education and employment significantly hindered economic growth in regions like the Middle East, North Africa, and South Asia.

Lee et al. (2012) took a more dynamic approach by employing a panel SVAR model to study the interaction among female employment, fertility, and economic growth in 23 countries. Their analysis revealed that variations in women's labor participation and fertility carry notable consequences for economic performance, particularly in the European Union, where the effects are stronger than in East Asian nations. Tsani et al. (2013) examine Southern Mediterranean economies using a two-stage strategy that combines econometric estimation with a computable general equilibrium framework to study the link between women's labour-force participation and economic growth. The econometric projections validate a U-shaped relationship and reveal region-specific constraints. These estimates are then fed into the CGE model to simulate how shifts in incomes and in female participation rates affect the economy. The simulations suggest that additional income yields only marginal gains in output, whereas higher female participation can exert a sizeable positive effect on growth. Yıldırım and Akıncı (2021) examined the impact of women's employment with per capita income in countries with moderate income levels between 2001-2016. The results of the study reveal a U-shaped relationship in middle income countries. In other words, women's employment increases as the income level increases.

Beyond income distribution and economic growth, the literature has also explored how macroeconomic variables such as inflation interact with female labour market participation. Niemi and Lloyd (1981), in a study covering the period between 1956 and 1977 in the United States, found that rising inflation rates encouraged greater female workforce participation, as households sought to compensate for declining purchasing power. Robu (2020) argued that increasing women's income could stimulate aggregate demand and eventually fuel inflation in the long run. Koyuncu and Okşak (2021) studied the Turkish context between 1990 and 2019 and similarly concluded that inflation had a long-run positive effect on women's labour force entry. Al Marhubi (2023), examining anti-discrimination laws across 117 countries from 1970 to 2019, noted that inclusive legal frameworks could moderate inflationary trends, possibly through their influence on broader labour market dynamics.

Dataset and Methodology

In the study, three European Union member states (Greece, Italy, and Spain) and Turkey, an EU candidate, were selected as sample countries. The reasons for selecting these countries are as follows; The introduction section presented data on variables such as Gini coefficients and female employment rates for Turkey, Greece, Italy, and Spain. As can be observed from this data, these countries have similar rates and rankings. Furthermore, these countries were specifically selected due to their similar socioeconomic and demographic profiles, as well as their shared exposure to regional economic dynamics such as EU integration processes, demographic transitions, and gender-related labor market challenges.

To investigate the relationship between female employment and income inequality, the analysis incorporates a set of macroeconomic indicators: the Gini index, the female employment rate, inflation and GDP per capita.

The dataset covers the period from 1991 to 2022, using annual data for each variable across the four countries. This extended time frame allows for the observation of long-term trends and the potential effects of major economic and policy shifts, such as the 2008 global financial crisis and recent developments in the 2020s. Table 1 presents comprehensive definitions and descriptions of all variables employed in the empirical analysis.

Table 1

Detailed Information About Variables

Variable Name	Description	Source
Gini	Gini Index calculated by Disposable Income	SWIID
Womanemployment	Employment to population ratio, 15+, female (%) (modeled ILO estimate)	World Bank/ WDI
GDP	GDP per capita growth (annual %)	World Bank/ WDI
CPI	Inflation, consumer prices (annual %)	World Bank/ WDI
HDI	Human Development Index	UNDP/ HDR

Note. Created by the author

The core objective of the study is to assess the impact of female employment on income distribution within the selected Mediterranean countries—Turkey, Greece, Italy, and Spain. To this end, an econometric model was developed in which income inequality serves as the dependent variable. The female employment rate is designated as the main explanatory variable.

In order to better isolate the effect of women's employment on income distribution, three macroeconomic control variables were incorporated into the model; Inflation rate, which may disproportionately affect lower-income groups and thereby influence income inequality, GDP per capita, which reflects the level of economic development and has long been debated in the context of the Kuznets hypothesis regarding inequality. In addition, the human development index, calculated with factors such as education, health and income, was included in the model because it contains elements that can positively affect women's employment.

Given the longitudinal and cross-sectional nature of the data (covering four countries over a 32-year period), a panel data analysis technique was deemed appropriate. This approach allows for the control of unobserved heterogeneity across countries and improves the robustness of causal inferences by leveraging both time-series and cross-sectional variation.

Descriptive statistics for all variables included in the model are presented in Table 2, offering insights into the central tendencies and dispersion characteristics of the dataset. The baseline econometric model formulated for the analysis is as follows:

$$Gini_t = \alpha_0 + \beta_1 Womenemployment + \beta_2 GDP + \beta_3 CPI + \beta_4 HDI + \varepsilon \quad (1)$$

Table 2

Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Gini	128	35.0835	3.6579	31	42.7
Womenemployment	128	71.9217	28.2054	20.5281	100
GDP	128	2.1081	4.1254	-10.9400	11.4394
CPI	128	11.3207	21.6010	-1.7358	105.215
HDI	123	0.8248	0.0784	0.602	0.912

Note. It was produced with the Stata package program.

The descriptive analysis of the dataset provides preliminary insights into the nature and variability of the variables across countries and over time. The average Gini coefficient across the four countries is calculated as 35.08, with values ranging from a minimum of 31 to a maximum of 42.7. This distribution reflects a moderate to high degree of income inequality among the selected Mediterranean countries throughout the 1991–2022 period.

The female employment rate exhibits considerable variation, with an average of 71.92% and a standard deviation of 28.21. This high level of dispersion suggests notable inter-country and temporal differences. It is plausible that this variation is largely driven by Turkey's relatively lower women's labour force participation during much of the observed period. Spain stands out as the country with a 100% female employment rate in 2021 and 2022.

In terms of macroeconomic conditions, the average annual GDP per capita growth rate stands at 2.11%, fluctuating between -10.94% and 11.44%. This wide range highlights the occurrence of significant economic cycles, including recessions and rapid expansions, within the study timeframe. Similarly, the inflation rate shows substantial variability, with an average of 11.32%, but ranging from negative values (deflation) to episodes where inflation exceeded 100%. This sharp volatility, particularly evident in Turkey's economic history, underscores the macroeconomic heterogeneity of the sample.

Collectively, the descriptive statistics underscore the importance of conducting rigorous econometric analysis to explore potential relationships among the variables, particularly the impact of female employment on income inequality. The pronounced variation in key indicators suggests that the underlying dynamics may differ significantly across countries and over time.

Prior to estimating long-term relationships, evaluating the stationarity characteristics of the time series is crucial. This step is critical for selecting appropriate cointegration methods and avoiding spurious regression results. In addition, the presence of cross-sectional dependence—i.e., correlation across countries—must be examined to determine the most

suitable unit root test. Neglecting cross-sectional interdependencies could lead to biased or inefficient test outcomes.

Accordingly, the study first tests for cross-sectional dependence across the variables. The outcomes of these diagnostic tests conducted both for individual variables and the overall model are presented in Table 3.

Table 3

Cross-Sectional Dependency Test Results

Test	Gini	Womenemployment	GDP	CPI	HDI
Breusch-Pagan LM	18.99107 (0.0042)	59.9664 (0.0000)	67.9827 (0.0000)	110.8740 (0.0000)	179.2428 (0.0000)
Pesaran scaled LM	3.7508 (0.0002)	15.578 (0.0000)	17.8929 (0.0000)	30.2745 (0.0000)	50.0109 (0.0000)
Pesaran CD	1.5232 (0.1278)	5.01588 (0.0000)	6.7288 (0.0000)	10.3733 (0.0000)	13.3839 (0.0000)

Note. It was produced with the Stata package program.

The initial step in the econometric analysis involves assessing whether the variables exhibit cross-sectional dependence, which refers to the existence of correlation among the countries in the panel. Formally, the null hypothesis H_0 posits no cross-sectional dependence, while the alternative hypothesis H_1 asserts the presence of interdependence among the cross-sectional units.

Based on the results of various diagnostic tests, the null hypothesis is rejected for all variables—except for the Gini coefficient under the Pesaran CD test. This outcome suggests that, in general, the variables are not cross-sectionally independent, and country-specific shocks or structural similarities may be influencing the data in a correlated manner.

These findings highlight the need to adopt second-generation panel unit root tests, which are designed to account for such cross-sectional dependencies. Unlike first-generation tests that assume independence across units, second-generation tests provide more reliable inference by adjusting for contemporaneous correlation that may otherwise bias the results (Şak, 2015)

Given that the panel dataset has a larger time dimension (T) relative to the cross-sectional dimension ($N = 4$), this study employs the CADF panel unit root test developed by Pesaran (2007). The CADF approach is particularly suitable in small-N, large-T panels, and corrects for cross-sectional dependence by including the cross-sectional averages of the dependent and lagged dependent variables in the regression framework.

CADF Panel Unit Root Test: Theoretical Rationale and Implementation

Evaluating the stationarity of variables is a critical initial step in panel data econometrics, as the presence of non-stationary series can produce misleading regression outcomes and invalid inferences. Although first-generation unit root tests—such as those introduced by Levin, Lin, and Chu (2002) and Im, Pesaran and Shin (2003)—are commonly used in empirical analyses, they are based on the restrictive assumption that cross-sectional

units are independent of one another. When this assumption is violated—due, for instance, to regional economic convergence or global shocks—the validity of their results becomes questionable.

To address this issue, Pesaran (2007) introduced the CADF test, a second-generation unit root procedure specifically designed to accommodate cross-sectional dependence in panel datasets. The test augments the conventional ADF regression for each cross-section by including the cross-sectional averages of the dependent variable and its lagged values, thereby capturing unobserved common factors that may induce correlation among units.

The key strength of the CADF approach lies in its ability to maintain robustness in the presence of cross-sectional correlation, which often arises in macroeconomic analyses due to shared economic linkages or synchronized policy responses. By controlling for these common influences, the CADF test enhances the reliability of stationarity assessments, especially in panels where N is relatively small and T is large, as in the case of this study.

The CIPS statistic (Cross-sectionally Im, Pesaran and Shin), derived as the average of individual CADF statistics, provides a summary measure for the panel as a whole. Both the CADF and CIPS tests have gained considerable popularity in applied macroeconomic research for their flexibility and consistency in dynamic panel settings.

In this study, the CADF test was employed to evaluate the stationarity properties of all variables included in the model. The test statistics were computed for each variable individually using the following regression specification:

$$\Delta_{a0t} = x_i + y_i a_{it-1} + z_i \bar{a}_{t-1} + w_i \Delta \bar{a}_t + \varepsilon \quad (2)$$

$$\Delta_{ai} = (\Delta_{ai1}, \Delta_{ai2}, \dots, \Delta_{aiT})', a_i, -1 = (a_{i0}, a_{i1}, \dots, a_{iT-1})' \quad (3)$$

The following hypotheses are tested with the t statistics calculated by these equations.

$H_0: a_i = 0$, the series is not stationary

$H_1: a_i < 0$, the series is stationary.

The CADF unit root test results for each variable generated from the above equations are presented in Table 4.

Table 4

CADF Unit Root Test Results

	At Level	
	Constant	Constant+Trend
Gini	-2.842 (0.012)	2.515 (0.345)
Womenemployment	-1.521 (0.709)	-2.305 (0.531)
GDP	-3.171 (0.002)	-3.248 (0.020)
CPI	-3.172	-3.627

	(0.002)	(0.002)
HDI	-2.475 (0.070)	-3.074 (0.048)
First Difference		
dGini	-2.918 (0.009)	-2.933 (0.008)
Womenemployment	-2.475 (0.070)	-2.967 (0.077)

Note. for models with constants, the critical values are -2.21 for 10%, -2.33 for 5% and -2.55 for 1%. For models with constants and trends, the critical values are -2.73 for 10%, -2.84 for 5% and -3.06 for 1%.

*** represents a 1% significance level, ** a 5% significance level and * a 10% significance level.

The t-statistics from the unit root tests performed on the variables were compared against the critical values provided by Pesaran (2007). The results indicated that the Gini index was stationary at level without any deterministic components, but it was non-stationary in models including a constant and a trend. Conversely, the female employment rate was found to be non-stationary in both models. The GDP, HDI and CPI variables, however, were stationary at level in both the model with only a constant and the model with a constant and trend. When first differences of the Gini index and female employment rate were taken, both variables became stationary at the 5% significance level across both model specifications. In summary, GDP, HDI and CPI were integrated of order zero, $I(0)$, whereas the Gini index and woman employment rate were integrated of order one, $I(1)$. This unit root test outcome justifies the application of the Panel ARDL method for cointegration analysis.

Panel ARDL Model

In panel data analysis, the varying orders of integration among variables necessitate selecting an appropriate econometric model. The Panel ARDL approach has become increasingly prominent in the literature because it accommodates both $I(0)$ and $I(1)$ variables within a unified modeling framework. This flexibility makes Panel ARDL particularly suitable for analyzing long-run relationships in datasets where variables exhibit different stationarity properties (Pesaran, Shin, & Smith, 1999).

This study employs an annual panel dataset comprising macroeconomic indicators such as the Gini index, the ratio of women to total employment, GDP per capita, CPI and HDI. Unit root testing revealed that GDP, HDI and CPI are stationary at level, whereas the Gini index and woman employment rate are stationary only after first differencing. Given that the variables are integrated at mixed orders, classical panel cointegration techniques—which assume uniform integration orders—are unsuitable. Accordingly, the Panel ARDL model offers an appropriate methodological alternative under these circumstances.

Panel ARDL's adaptable structure facilitates the simultaneous examination of short-term dynamics and long-term associations. Estimation techniques within this framework allow heterogeneity in short-run coefficients and error correction speeds across cross-sectional units (countries or entities), while potentially imposing restrictions on long-term coefficients. Among the estimation methods, the Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed Effects (DFE) estimators are most commonly applied (Pesaran, Shin, & Smith, 1999).

Table 5*Results of MG and DFE Estimator*

Variables	MG	DFE
Womenemployment	-0.1163 (0.0000)	-0.0162 (0.0980)
CPI	0.0560 (0.000)	0.0263 (0.0000)
GDP	-0.0269 (0.2853)	-0.0270 (0.1070)
HDI	9.1920 (0.0006)	0.1788 (0.9280)
Heteroskedasticity	2.52 (0.1150)	27.28 (0.0000)
Autocorrelation	1813.177 (0.0000)	1106.59 (0.0001)
Hausman	129.58 (0.0000)	

Note. It was produced with the Stata package program.

Before estimating the panel ARDL model, the MG and DFE models were also estimated to check whether the variables and model used were free of heteroscedasticity and autocorrelation issues. The analyses revealed that the GDP variable was statistically insignificant, while the other variables were largely statistically significant. However, both models were found to have heteroscedasticity and autocorrelation issues. Therefore, the study employed a robust model that is resistant to clustering error terms. When the Hausman test statistics and prob. values were examined, it was determined that the random effects estimator was inconsistent and the fixed effects estimator was effective because the H_0 hypothesis was rejected.

In the Mean Group method, each panel unit is estimated individually, with the long-run estimates then averaged to obtain overall coefficients. This method assumes complete heterogeneity in both short-run and long-run coefficients across units (Pesaran & Smith, 1995).

In contrast, the Pooled Mean Group (PMG) estimator assumes that while short-run dynamics and speed of adjustment (error correction terms) may vary across units, the long-run cointegrating relationship is homogeneous and common to all units. Thus, the PMG approach allows generalization of the long-term equilibrium relationship to the entire panel. It also facilitates cointegration analysis by explicitly incorporating an error correction mechanism, which tests for the existence of long-run equilibrium between the variables (Blackburne & Frank, 2007).

The Panel ARDL model examining the relationship between the dependent and independent variables can be formally expressed as follows:

$$Gini_{it} = a_i + \sum_{p=1}^4 \varphi_{ip} Gini_{i,t-p} + \sum_{q=0}^4 \beta_{1iq} WEMP_{i,t-q} + \sum_{r=0}^4 \beta_{2ir} Inf_{i,t-r} + \sum_{s=0}^4 \beta_{3is} GDP_{i,t-s} + \sum_{s=0}^4 \beta_{4is} HDI_{i,t-s} + \varepsilon_{it} \quad (4)$$

In the equation, i represents the country index, t represents time, Gini represents the dependent variable, WEMP represents the female employment rate, Inf represents inflation, GDP represents GDP per capita and HDI represents human development index. In the presence

of a cointegration relationship, the following equation is used to determine the long-term relationship.

$$Gini_{it} = \gamma_{0i} + \gamma_{1i}WEMP_{it} + \gamma_{2i}Cpi_{it} + \gamma_{3i}Gdp_{it} + \gamma_{4i}Hdi_{it} + \mu_{it} \quad (5)$$

In Equation 5, the expression γ represents the long-term coefficients, while the expression μ_{it} represents the long-term error term.

A crucial assumption for the validity of Panel ARDL models is that none of the variables are integrated of order. This requirement stems from the fact that the ARDL methodology is only applicable to series integrated of order zero, or order one; the presence of I(2) variables violates the model's assumptions and can lead to inconsistent estimations (Nkoro & Uko, 2016). Since some variables in this study are stationary at level while others become stationary after first differencing, the necessary conditions for employing the Panel ARDL approach are satisfied.

Moreover, the Panel ARDL model facilitates both causality analysis and the dynamic modelling of shock transmission over time. In addition to estimating long-term parameters, the model facilitates the interpretation of the error correction term, which reflects the rate at which short-term disequilibria adjust back to long-run equilibrium. A negative and statistically significant coefficient on this term indicates the presence of a stable long-run cointegration relationship among the variables. The Akaike Information Criterion (AIC) was used to determine the number of lags. Consequently, a model was created with lags PMG(1, 2, 1, 1, 2). The empirical findings derived from this model estimation are summarized in Table 6.

Table 6

Panel ARDL (1, 2, 1, 1, 2) Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-run Coefficients				
WOMENEMPLOYMENT	-0.1169	0.0100	-11.6442	0.0000
CPI	0.0428	0.0044	9.6472	0.0000
GDP	-0.0266	0.0276	-0.9614	0.3383
HDI	10.0442	1.9704	37580	0.0003
Short-run Coefficients				
EC	-0.1044	0.0543	-1.9231	0.0571
D(GINI)	0.5620	0.0763	7.3597	0.0000
D(WOMENEMPLOYMENT)	-0.0069	0.0078	-0.8014	0.4246
D(WOMENEMPLOYMENT(-1))	-0.0210	0.0078	-2.6946	0.0082
D(INFL)	-0.0385	0.0212	-1.8107	0.0729
D(GDP)	-0.0002	0.0190	-0.0146	0.9883
D(HDI)	-17.3281	20.6712	-0.8382	0.4037
D(HDI(-1))	4.3313	16.1403	0.2683	0.7889

Note. It was produced with the Stata package program.

According to the results presented in Table 6, the long-term coefficients of the GDP are not statistically significant, whereas the coefficients for HDI and CPI are significant. Specifically, the inflation rate exhibits a positive long-term effect on income inequality, with a 1% increase in inflation leading to a 0.04% increase in the Gini index. In contrast, womenemployment has a negative long-term impact, where a 1% increase in woman employment corresponds to a 0.11% reduction in income inequality.

Findings from the short-term dynamics indicate a negative and significant error correction term, suggesting that the system converges toward long-run equilibrium. The

coefficient value suggests that approximately 10% of the disequilibrium is corrected within one year, implying that the model converges back to equilibrium over a period of around five years and eight months.

While GDP and HDI does not have a statistically significant short-term effect, the lagged first differences of the Gini index and female employment rate both exert statistically significant influences. Notably, the negative short-term coefficient of female employment implies that increases in female employment contribute to a partial reduction in income inequality in the short run.

Panel Granger Causality Analysis

In empirical research employing panel datasets, investigating the causal relationships between variables is essential for formulating effective policy recommendations. Panel Granger Causality Analysis represents an extension of the conventional Granger causality test for time series data, adapted to accommodate both temporal and cross-sectional dimensions inherent in panel data structures (Dumitrescu & Hurlin, 2012).

Under the Granger causality framework, X Granger-causes Y when lagged observations of X improve forecasts of Y more than using only Y's own previous values. (Granger, 1969). Importantly, this notion of causality reflects improvements in forecast accuracy rather than implying a deterministic causal mechanism.

Before conducting panel Granger causality tests, it is critical to establish the stationarity properties of the variables involved. Applying Granger causality tests directly to non-stationary variables may yield spurious or misleading results (Toda & Yamamoto, 1995). Therefore, unit root testing should precede causality analysis to ensure stationarity. For variables that are non-stationary but cointegrated, Granger causality testing should be implemented within an error correction model (VECM) framework to capture both short-run dynamics and long-run equilibrium relationships (Engle & Granger, 1987).

In this study, the Panel Granger Causality Analysis is applied to an annual panel dataset to examine the causal interactions between the Gini index, female employment rate, GDP, and inflation rate. This approach enables identification of unidirectional or bidirectional causal links, particularly focusing on whether female employment has a causal effect on income inequality.

The findings of the Panel Granger Causality analysis provide valuable insights for policymakers by clarifying the causal impact of female employment on income distribution. Moreover, these results contribute to a deeper understanding of the indirect channels through which female labor participation may influence economic growth and price stability. The detailed empirical outcomes of this causality analysis are summarized in Table 7.

Table 7*Panel Granger Causality Analysis Results*

H ₀	Obs	F-Statistic	Prob.
WOMENEMPLOYMENT does not Granger Cause GINI	120	3.2815	0.0411
GINI does not Granger Cause WOMENEMPLOYMENT		4.3062	0.0157
INFL does not Granger Cause GINI	120	0.0347	0.9658
GINI does not Granger Cause INFL		2.6158	0.0774
HDI does not Granger Cause GINI	120	0.8356	0.4361
GINI does not Granger Cause HDI		0.1012	0.9037
GDP does not Granger Cause GINI	120	0.5468	0.5802
GINI does not Granger Cause GDP		4.2264	0.0169
INFL does not Granger Cause WOMENEMPLOYMENT	120	2.0203	0.1372
WOMENEMPLOYMENT does not Granger Cause INFL		2.6417	0.0755
HDI does not Granger Cause WOMENEMPLOYMENT	120	0.9454	0.3915
WOMENEMPLOYMENT does not Granger Cause HDI		2.0476	0.1337
GDP does not Granger Cause WOMENEMPLOYMENT	120	0.0688	0.9335
WOMENEMPLOYMENT does not Granger Cause GDP		4.4853	0.0133
HDI does not Granger Cause INFL	120	0.0755	0.9273
INFL does not Granger Cause HDI		5.4774	0.0053
GDP does not Granger Cause INFL	120	5.7425	0.0041
INFL does not Granger Cause GDP		0.8123	0.4463
GDP does not Granger Cause HDI	120	3.7660	0.0260
HDI does not Granger Cause GDP		2.9097	0.0585

Note. It was produced with the Stata package program.

The analysis reveals a bidirectional Granger causality between woman employment rates and Gini coefficient. This finding suggests a reciprocal relationship, whereby changes in woman employment influence income distribution, and conversely, variations in income inequality affect female employment levels. Inflation, however, does not appear to Granger-cause income inequality, although there is limited evidence suggesting that income inequality may have some influence on inflation.

Regarding GDP, the results indicate that economic growth does not Granger-cause income inequality, yet income inequality is found to Granger-cause GDP. Similarly, inflation has no significant causal effect on female employment, while there is some indication that female employment may exert a limited causal influence on inflation.

Furthermore, economic growth does not seem to causally explain female employment, whereas the female employment rate has a significant causal effect on GDP. Lastly, GDP is found to Granger-cause inflation, but inflation does not Granger-cause GDP. A bidirectional causality relationship is observed between GDP and HDI at 10% and 5% significance levels.

Conclusion

This study investigated the impact of female employment rates on Gini index using panel data from Turkey, Greece, Italy, and Spain. Analysis using the panel ARDL model revealed that female employment has a statistically significant long-run effect on the Gini index. Furthermore, one-lagged increases in female employment in the short run contribute to a decline in the Gini index. These results are consistent with the studies of Costa et al. (2009) and Asongu and Odhiambo (2019). The results indicate that long-run inflation worsens the Gini index and tends to lower the HDI.

The Panel Granger Causality analysis further demonstrated a bidirectional causal relationship between female employment and Gini index, highlighting the significant role of women's economic participation in shaping social inequalities. A weak causal effect of Gini index on inflation was also identified at the 10% significance level, suggesting that social inequalities may indirectly influence economic growth through price pressures or demand-side imbalances, although this requires further investigation. The result encountered here is parallel to the study of Robu (2020). The observed unidirectional causality from Gini index to GDP implies that inequality can impact economic growth, potentially through mechanisms such as consumption, investment, or social cohesion.

The effect of female employment on inflation was found to be weak, which may indicate that employment growth generates an indirect price effect via increased consumption demand. Notably, female employment was shown to have a significant positive causal effect on GDP, underscoring the macroeconomic importance of gender equality for economic growth. The bidirectional relationship between HDI and GDP shows that positive developments in education, health and income can contribute to the economic growth of the country and this contribution can increase the human development index again. Finally, GDP was found to Granger-cause inflation but not vice versa, suggesting that increases in production and income influence price levels, particularly during demand-driven growth periods.

The findings for Turkey, Greece, Italy, and Spain highlight the necessity of policies that enhance female labor force participation while addressing income inequality, inflation, and broader human development outcomes. Increasing women's employment is a common challenge across these countries, but the policy priorities differ according to structural conditions. In Turkey, low female labor force participation combined with high inflation reduces household welfare and amplifies income inequality. Publicly funded childcare, flexible work arrangements, and targeted vocational training can strengthen women's access to formal employment and mitigate distributional gaps. In Greece, female participation remains below the EU average despite declining unemployment. Internship and hiring subsidies for young women, together with measures that formalize and stabilize female employment in the tourism sector, would support both equity and sustainable growth. Well-targeted social transfers could further accelerate improvements in the Gini coefficient. Italy faces a dual challenge of low female employment and demographic aging. Tax and contribution incentives for working mothers, combined with public investments in the care economy, can boost female participation while addressing regional disparities, particularly in the South. Spain performs relatively better in terms of female labor participation, yet high housing and living costs hinder stable integration of young women into the labor market. Affordable housing schemes and family support programs, complemented by leadership and mentoring initiatives that advance women into senior positions, would reduce structural inequality. Overall, policy experiences across these countries suggest that childcare provision, inflation-indexed social transfers, vocational training, and female entrepreneurship support are critical instruments to promote inclusive

growth. By aligning labor market reforms with gender-sensitive strategies, governments can simultaneously foster economic growth, lower income inequality, and enhance human development.

This study has several limitations. The model includes a limited set of macroeconomic variables, omitting potentially influential factors such as education levels and sectoral employment composition. Furthermore, the use of annual data may limit the analysis of short-term dynamics. Future research is recommended to explore these relationships in greater depth using more granular datasets and micro-level analyses.

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Information About the Article/Makale Hakkında Bilgiler

The Ethical Rules for Research and Publication / Araştırma ve Yayın Etiği

The author declared that the ethical rules for research and publication followed while preparing the article.

Yazar makale hazırlanırken araştırma ve yayın etiğine uyulduğunu beyan etmiştir.

Conflict of Interests/ Çıkar Çatışması

The author have no conflict of interest to declare.

Yazar çıkar çatışması bildirmemiştir.

Grant Support/ Finansal Destek

The author declared that this study has received no financial support.

Yazar bu çalışma için finansal destek almadığını beyan etmiştir.

Author Contributions/ Yazar Katkıları

The draft process of the manuscript/ Taslağın Hazırlanma Süreci S.G., Data Collection/Verilerin Toplanması S.G, Writing The Manuscript/ Makalenin Yazılması S.G., Submit, Revision and Resubmit Process/ Başvuru, Düzeltme ve Yeniden Başvuru Süreci S.G.