Sosyoekonomi

2024, Vol. 32(62), 95-114

RESEARCH ARTICLE

ISSN: 1305-5577
DOI: 10.17233/sosyoekonomi.2024.04.05
Date Submitted: 07.01.2024
Date Revised: 04.02.2024
Date Accepted: 11.08.2024

Analysis of Female Employment Rates in Türkiye with Duration Variable Spatial Logit and Duration Variable Spatial Probit Models

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Türkiye'de Kadın İstihdam Oranlarının Süre Değişkenli Mekânsal Logit ve Mekânsal Probit Modelleri ile Analizi

Abstract

Female employment holds significant importance in achieving sustainable economic growth. In this regard, initiatives aimed at increasing female employment are among the fundamental goals of countries. Studies on female employment are expected to assist in developing strategies and policies that guide countries in reaching their relevant objectives. This study aims to investigate the spatial interactions and determinants of female employment rates in Level-2 regions in Türkiye during the 2018-2020 period using duration variable spatial logit and duration variable spatial probit models. The analysis revealed findings indicating a positive impact on education levels and a negative impact of the Gini coefficient and the duration variable on female employment rates. The findings related to the duration variable suggest a decreasing likelihood of female employment rates being above the median value during the 2018-2020 period.

Keywords : Female Employment, Spatial Data Analysis, Duration Variable, Spatial Qualitative Choice Models.

JEL Classification Codes : C21, E24, D33.

Öz

Kadın istihdamı, sürdürülebilir ekonomik büyümenin sağlanması hususunda oldukça büyük önem arz etmektedir. Bu doğrultuda kadın istihdamının artırılmasına yönelik girişimler, ülkelerin temel hedefleri arasında yer almaktadır. Kadın istihdamı üzerine yapılacak çalışmaların, ülkelerin ilgili hedeflere ulaşmaları hususunda yol gösterici olacak strateji ve politikaların geliştirilmesinde yardımcı olması beklenmektedir. Bu bağlamda çalışmanın amacı, 2018-2020 döneminde Türkiye'de Düzey-2 bölgelerinde kadın istihdam oranlarının mekânsal etkileşimlerini ve belirleyicilerini, süre değişkenli mekânsal logit ve mekânsal probit modelleri ile araştırmaktır. Analiz neticesinde, kadın istihdam oranları üzerinde eğitim düzeylerinin pozitif, Gini katsayısı ile süre değişkeninin ise negatif etkiye sahip olduğuna yönelik bulgular tespit edilmiştir. Süre değişkenine dair elde edilen bulgu, 2018-2020 dönem aralığında kadın istihdam oranının medyan değerin üzerinde olma olasılığının giderek azaldığını göstermektedir.

Anahtar Sözcükler : Kadın İstihdamı, Mekânsal Veri Analizi, Süre Değişkeni, Mekânsal Nitel Tercih Modelleri.

1. Introduction

One of the crucial indicators used to determine the level of development in countries is the female employment rate. However, in Türkiye, classified as a developing country, it is known that the female employment rates lag behind those of men, which is attributed to gender inequality. According to data from the World Economic Forum, Türkiye ranks 130th out of 153 countries in the Global Gender Gap Index and holds the 136th position for economic participation and opportunity equality (World Economic Forum, 2020: 343). At this point, to reduce gender inequality and ensure sustainable economic growth in Türkiye, efforts should be made to increase employment opportunities, and necessary social strategies should be developed.

Another significant reason for emphasising female employment rates is that it is a crucial tool in reducing informal employment. The increase in employment opportunities for women in fields where they can work under favourable conditions is expected to prevent informal employment (Aksu, 2022: 161).

Education is crucial in both women's and men's employment rates. It is noted that education has a higher impact on female employment rates (TÜSİAD, 2002: 52). However, the effects of education on female employment vary between countries (Steiber et al., 2016: 246). In this context, the study aims not only to identify the impact of different education levels on female employment in Türkiye but also to profile the educational portfolios of women in employment.

It is emphasised that when making model predictions by disregarding the spatial distributions of certain factors, such as unemployment, poverty, wages, and other labour market-related elements, and assuming that units are independent of each other, encountering inevitably inaccurate statistical results is unavoidable (Stops et al., 2012: 2). In this context, the primary objective of the study is to identify the effects of different education levels and income distribution inequality on female employment in Türkiye, while additionally aiming to explore spatial interactions within Level-2 regions.

When reviewing the existing literature on spatial qualitative choice models, it is commonly noted that the temporal dependence between observations needs to be noticed. However, the omission of this dependence has a negative impact on the accuracy of prediction results. Therefore, the study aims to contribute meaningfully to the relevant literature by employing duration variable spatial qualitative choice models. Two key factors influenced the study's selection between 2018 and 2020. Firstly, regional data is limited in Türkiye. Secondly, the study distinguishes itself by underscoring the significance of incorporating duration variables in spatial qualitative choice models. It is a distinctive approach compared to other studies utilising longer time intervals, marking a stage still in development.

2. Economic Theory

2.1. The Structure of Female Employment in Türkiye

There are various definitions of the concept of employment in the literature. The Turkish Statistical Institute (TÜİK), which provides one of these definitions, explains the concept of employment as follows: "Those who engage in economic activities for at least one hour during the reference week and earn income from this activity (including unpaid family workers) or those who are temporarily not at work for any reason but still have a connection with their jobs are considered employed" (TÜİK, 2022: 8).

Employed individuals are divided into two groups based on their job motivations. Individuals with intrinsic job motivation carry out their work with a desire for personal development, while those with extrinsic job motivation see their work as a means to an end (Gesthuizen & Verbakel, 2011: 264). Ester et al. (2006) state that if individuals in employment have intrinsic job motivation, society can have a much higher strength in competition with other countries in the globalised economy (Ester et al., 2006: 93-94).

Employment rates that enhance a country's competitiveness are crucial in eliminating gender inequalities between women and men. The non-employment of women leads to an increase in gender inequality and prevents women from achieving economic freedom (Ecevit, 2008: 118). However, it is anticipated that the employment increase brought by women working in low-paid and insecure conditions will not negatively affect gender inequality. On the contrary, it is expected to worsen the social status of women within society (İğde, 2011: 152).

Table 1 provides employment rates for Level-2 regions in Türkiye from 2018-2020.

Table: 1
Employment Rates

District	2018			2019			2020		
	F	M	T	F	M	T	F	M	T
TR10	32	68,6	50,2	30,5	67,1	48,9	28	62,1	44,8
TR21	35	75	55,3	34	71,3	53	33,6	67,9	50,9
TR22	29,8	63,3	46,3	28,8	60,8	44,3	28,4	59,9	44
TR31	31,2	66,1	48,5	30,8	63,8	47,2	27,2	58,9	42,9
TR32	38,2	68,2	53	37,5	65,2	51,2	31,4	60,9	46,2
TR33	32,7	68,1	50,3	30,9	64,9	47,6	29,2	63,7	46,4
TR41	30,5	65,8	48,2	28,5	62,6	45,5	27,4	61,6	44,5
TR42	29,1	68,9	49,3	28,6	65,4	46,8	26,1	63,1	44,4
TR51	28	66,7	47,2	27,6	63,7	45,3	25,7	60,6	42,8
TR52	27,7	69	47,7	27,6	67,7	46,9	25,2	65,1	44,7
TR61	34,1	66,4	50,3	33,9	64,6	49,2	32,6	61,5	47
TR62	27,4	62,4	44,5	27,5	60,3	43,6	23,9	57,8	40,6
TR63	24,2	61,7	42,4	22,1	57,5	39,2	20,7	54,9	37,5
TR71	27,2	65,6	45,9	27,4	62,9	44,5	23,9	60,2	41,9
TR72	21,4	62,8	41,6	21,2	60,1	40,6	21,4	57,4	39,2
TR81	30,1	62,5	45,9	31,8	61	46,2	27,8	57,9	42,8
TR82	40,4	67,7	53,7	36,1	63,2	49,3	34	60,9	47,2
TR83	36,8	67,2	51,7	34,6	65,2	49,4	30,5	62,1	45,9
TR90	37,7	65,4	51,3	38,6	63,7	50,8	34,7	61,5	48
TRA1	25,6	64,2	44,6	24,5	61,3	42,5	24,5	61,2	42,5
TRA2	29,6	65	47,6	28	56,8	42,8	25,5	52,6	39,1

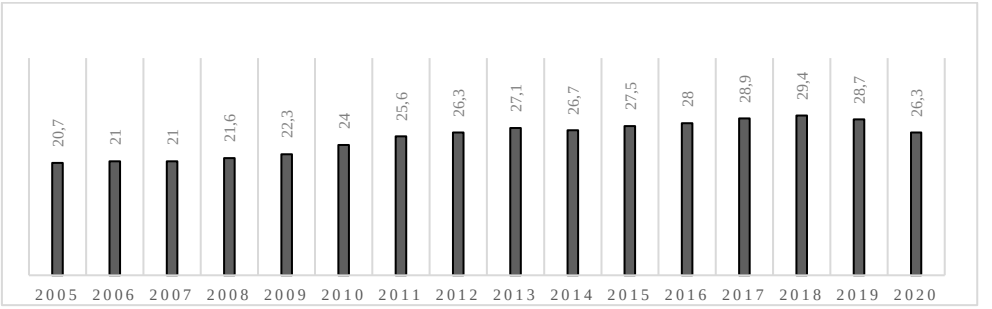
TRB1	30,4	66,6	48,1	30,5	63,2	46,4	24,5	59,9	41,7
TRB2	19,5	56,9	38,2	20,1	55,4	37,8	20,1	52,4	36,4
TRC1	19,2	62,6	40,9	20,7	60,3	40,2	20,4	62,5	41,6
TRC2	20,3	58,6	38,9	19,7	52,2	35,7	15,1	46,9	30,7
TRC3	11,9	50,8	30,5	12,4	49,4	30	12,6	40,4	26
Average	**29,4**	65,7	47,4	**28,7**	63,1	45,7	**26,3**	59,8	42,8

Note: F: Female, M: Male, T: Total.
Source: Türkiye İstatistik Kurumu, 2023.

When evaluating the employment rates of women and men for 2018, 2019, and 2020 in Table 1, it is evident that women lag significantly behind men, indicating gender inequality in employment. This situation is attributed to social gender inequality as the cause of gender disparity in employment.

Figure 1 illustrates the trend of female employment rates over 15 years for a more comprehensive interpretation.

Figure: 1
Female Employment Rates in Türkiye



Source: Türkiye İstatistik Kurumu, 2023.

Figure 1 shows a general upward trend despite declining female employment rates in 2019 and 2020. Özar (2009) emphasises the impact of the increase in women working in less skilled and lower-paid jobs on the overall rise in female employment in Türkiye, drawing attention to the unfavourable conditions behind the employment increase. She attributes this situation to the patriarchal system in Türkiye, stating that employers tend to hire women for low-wage and low-skilled jobs (Özar, 2009). Özer and Biçer (2003) provide supporting evidence, noting that women in Türkiye are more present in rural labour markets than urban labour markets, with many working as unpaid family workers in these markets (Özer & Biçer, 2003: 56). This situation is reflected in the employment rates in the agricultural sector obtained from the TÜİK database and presented in Table 2.

Table: 2
Employment Rates in the Agricultural Sector

2018		**2019**		**2020**	
F	**M**	**F**	**M**	**F**	**M**
26,1	14,9	25,1	14,9	22,8	15,3

Note: F: Female, M: Male.
Source: Türkiye İstatistik Kurumu, 2022b: 107.

In Table 2, women are more employed in the agricultural sector than men; however, the employment rates in the agricultural sector decreased over the relevant years, similar to the overall employment rates.

In Türkiye, particularly in recent years, the decline in the employment rates in the agricultural sector has made it increasingly challenging for women working in low-skilled jobs to participate in the labour force in other sectors and urban markets. This situation has resulted in a decrease in female employment rates. Women who find employment often transition to the service sector, working in low-skilled jobs. In this context, it is stated that the simultaneous decrease in employment in the agricultural sector and the increase in urbanisation rates have led to a decline in female employment (Kızılgöl, 2012: 89; Pekel, 2018: 40).

Unsurprisingly, women living in large cities with higher education levels than the general population may prefer to refrain from participating in employment when they cannot find jobs that meet their desired standards. In other regions, it is noted that women with relatively lower education levels tend to turn to low-skilled jobs under challenging conditions (Özvarış, 2015: 42). Particularly in these regions, where women, often with low levels of education, are reported to work as unpaid family workers in the agricultural sector, it is stated that they contribute to a virtual increase in employment. The data from Table 1, indicating that two of the top three regions with the highest female employment rates in Level-2 regions in the respective years (TR82 and TR90) are also the regions with the highest agricultural employment rates according to TÜİK data, support this observation.

2.2. Effects of Education and Income Distribution Inequality on Female Employment

There is a consensus in the literature that education enhances employment rates, regardless of gender. Education is expected not only to improve individuals' abilities but also to increase overall welfare within society. Chatterjee et al. (2018) mention that in developed countries, there is an increase in the labour force and, indirectly, in employment with education. However, due to complex socio-economic phenomena, different outcomes can be encountered in low and middle-income countries. They emphasise factors such as gender inequality, traditional structures, and family dynamics as fundamental reasons for these variations (Chatterjee et al., 2018: 858).

Several studies argue for an inverse relationship between female employment rates and income inequality. Increasing female employment is suggested to be more effective than fiscal policies in reducing income inequality (Özcan, 2023: 163; Goulart et al., 2023).

While many societal factors disrupt income distribution equality, more than limiting income inequality solely to employment and unemployment issues will be required to solve this problem. Wage inequality and its demographic impacts are crucial determinants of income distribution inequality (Aktaş, 2022: 4). In addition to wage inequality, education,

social factors, and government policies also play significant roles in income distribution inequality (Özcan, 2023: 163). Furthermore, education positively impacts economic growth and mitigates income distribution inequality (Kumar, 2023: 2).

Due to the multifaceted nature of educational inequality, which affects both individuals and society, it is emphasised that ensuring equal distribution of educational opportunities between women and men and achieving equality in education are as crucial as ensuring income distribution equality. Educational equality is important for economic development and employment rates (Kumar, 2023: 2).

3. Literature Review

The labour force concept encompasses not only those currently employed but also individuals who are prepared to work but are not currently active and those actively seeking employment (Pekel, 2018: 49; Eroğlu, 2008). Starting from the notion that the labour force constitutes employment, studies examined factors influencing female labour force participation alongside female employment (Pekel, 2018: 49; Eroğlu, 2008).

The study conducted by Tansel (2002) investigated the factors determining women's labour force participation rates across 67 provinces in Türkiye during different periods and found that economic growth and an increase in educational levels contributed to higher rates of female labour force participation.

In their study examining factors influencing female employment in Chile, Contreras and Plaza (2010) asserted that, within the cultural framework, patriarchal structures, education level, marital status, and age played pivotal roles in determining employment outcomes. The study's conclusion highlighted that increased education levels were associated with higher employment rates. Conversely, being married was found to decrease the corresponding employment rate.

In Kızılgöl's (2012) study, conducted between 2002 and 2008 in Türkiye, the author examined the factors influencing the labour force participation of married and unmarried women in urban and rural areas through a logistic regression model. The study's findings indicated that education level, dependency ratio, household income, property ownership, and age influenced female labour force participation. Notably, the results revealed that an increase in education level positively impacted labour force participation for married and unmarried women, while an increase in household income had the opposite effect. Additionally, it was observed that the impact of education on women living in urban areas was significantly higher than that of women living in rural areas.

In their study investigating the determinants and spatial interactions of female employment rates in Nigeria, Gayawan and Adebayo (2015) utilised data from the 2008 Population and Health Survey. The researchers identified regional interactions in female employment and highlighted age, marital status, and educational level as critical determinants of female employment.

Mollaibrahimoğlu (2016), in her examination of female employment in Türkiye, emphasised that lack of education and low educational attainment posed significant obstacles to female participation in the labour force and that marriage and motherhood negatively impacted female employment rates.

In a study spanning from 1989 to 2018 in Türkiye, Aksoy et al. (2019) employed the ARDL bounds testing approach to analyse the determinants of female employment. Their findings revealed that the most influential factors on employment rates were the number of married women and unemployment.

Güriş et al. (2019) utilised panel qualitative choice models to examine the determinants of female employment in OECD countries from 2004 to 2016. The analysis concluded that the increased number of women enrolled in higher education positively impacted female employment.

In his study investigating the effects of female labour force participation on income inequality in Türkiye during the period 1988-2015 through the ARDL bounds testing approach, Arda Özalp (2021) found that an increase in the rate of female labour force participation resulted in a reduction in inequality.

Gönülaçan Özer and Karcı (2022) endeavoured to pinpoint regional disparities in Türkiye's employment landscape in their study. Utilising the data from 2017, they conducted a spatial econometric analysis specifically focused on Level-2 regions. The spatial data analysis revealed a positive spatial dependence regarding female employment rates among regions.

Sarı's (2022) study used a time-series analysis to investigate the relationship between female employment rates and income distribution inequality in Türkiye. The results indicated that the increase in female employment during 2004-2015 contributed to a reduction in the Gini coefficient, a measure of income inequality.

In her study spanning the period 2006-2020 and focusing on selected European Union member states, Türkiye, Özcan (2023) asserted that a high female employment rate had corrective effects on income inequality and that the female employment rate differentially reduced income inequality in countries belonging to distinct income groups.

Özocaklı and Khanalizadeh (2023) examined the socio-economic variables influencing female employment in Türkiye from 2010 to 2022. Their research found that including the higher education graduation rate as a socio-economic variable in the model increased female employment rates for women aged 15-24 and those aged 25 and above.

4. Methodology

The spatial effects of interactions between locations are categorised into spatial dependence and heterogeneity. Spatial dependence is defined as the similarity of location values due to proximity (Anselin, 1988:16).

Despite the scarcity of studies addressing spatial interactions in qualitative choice models, it's crucial to understand that neglecting spatial effects can significantly undermine the statistical reliability of estimators. Therefore, in qualitative choice models, considering spatial effects is important and necessary for obtaining reliable estimation results, especially when such effects are present.

The need for more spatial linear probability models to explain spatial effects has led the literature on spatial qualitative choice models to predominantly evolve through spatial logit and spatial probit models. This evolution underscores the need for alternative models, such as the spatial probit model, which is considered more popular and is often preferred over the spatial logit model.

In the literature on spatial interactions, spatial autoregressive dependence (SAR) reigns supreme regarding interactions between locations. With their informative nature regarding spatial spreads, these models are the cornerstone of spatial interactions, emphasising and highlighting the dominance of models that involve spatial autoregressive dependence (Billé & Leorato, 2017: 3).

The matrix representation of qualitative choice models incorporating spatial autoregressive dependence (SAR) is provided in Equation 1.

$$y^* = \rho W y^* + X\beta + \varepsilon \tag{1}$$

In the equation, W denotes the spatial weight matrix, y^* represents the unobservable dependent variable with dimensions nx1, X is the vector of explanatory variables, β is the coefficient vector, ρ is the spatial coefficient for the dependent variable, and ε signifies the independent and identically distributed error term (Fleming 2004: 148).

Klier and McMillen (2008) introduced the Linearized Generalized Method of Moments (LGMM) as a prediction method for spatial qualitative choice models. LGMM applies to both spatial logit and spatial probit models and can be employed with large samples (Klier & McMillen, 2008: 460-461).

The general steps of the estimation procedure for the LGMM method are outlined below. In the LGMM method, the generalised logit residuals, denoted as ($\tilde{u}_i$), in Equation 2, are estimated using initial values for parameters as in Equation 3.

$$\tilde{u}_i = y_i - P_i \tag{2}$$

$$\tilde{u}_i^0 = y_i - P_{i0} \tag{3}$$

P_i in the equation represents the probability of an event occurring.

After determining the initial values for the generalised logit model, the gradient terms for β and ρ, as mentioned in Equation 4, are calculated (Klier & McMillen, 2008: 462).

$$G_{\beta_i} = P_i(1 - P_i)\, X_i^{**} \tag{4}$$

$$G_{\rho_i} = P_i(1 - P_i)\left[H_i\beta - \frac{X_i^{**}\beta}{\sigma_i^2}\Lambda_{ii}\right]$$

X^{**} in Equation 4 represents the normalized version of the variable X^* (where $X^* = (I - \rho W)^{-1}X$), addressing the issue of varying variance.

Upon examining the equations, it can be observed that while calculating G_{β_i} is mathematically straightforward, the equation for obtaining G_{ρ_i} is complex due to the presence of the nxn matrix represented by Λ_{ii} in Equation 5.

$$\Lambda = (I - \rho W)^{-1}W(I - \rho W)^{-1}(I - \rho W)^{-1} \tag{5}$$

At this point, Klier and McMillen (2008) propose linearising the model at the starting point by suggesting the equality $\rho_0 = 0$ (Klier & McMillen, 2008: 462).

Following the linearisation process, the gradient terms, computed alongside the estimation of the classical logit model, are provided below.

$$G_{\beta_i} = \hat{P}_i(1 - \hat{P}_i)\, X_i \tag{6}$$

$$G_{\rho_i} = \hat{P}_i(1 - \hat{P}_i)H_i\hat{\beta}$$

Due to the linearization process, $(I - \rho W)^{-1} = I$, and the instrumental variables matrix is defined as $H = WX$.

In the final stage of the estimation procedure, first, the values $\hat{G}_\beta$ and $\hat{G}_\rho$ are obtained through the two-stage least squares method. Subsequently, the coefficients β and ρ are estimated using the equation $\tilde{u}^0 + G'_\beta\hat{\beta}_0$ (Klier & McMillen 2008: 462).

Although the LGMM method may yield biased estimation results depending on the magnitude of the spatial correlation coefficient, its frequent preference in estimating spatial logit and spatial probit models is attributed to its lower mathematical computational burden, applicability to large samples, and versatility.

Before estimating spatial qualitative choice models, testing for spatial dependence in models is crucial. In spatial dependence, one should proceed to the estimation stage of the relevant models using the LGMM method. For this purpose, Kelejian and Prucha (2001) developed a version of Moran's I test specifically for investigating spatial dependence in

probit and tobit models (Qu & Lee, 2012: 431). It is noted that the developed Moran's I test provides reliable results for samples (Amaral et al., 2013: 100-101).

In qualitative choice models, when there is temporal dependence among observations, neglecting this dependency structure in the model diminishes the statistical reliability of the estimation results. Modelling temporal dependence among observations is crucial for estimation results. However, the methodology for spatial panel qualitative choice models that include the time dimension is still in the developmental stage. In this context, various approaches have been proposed in the literature to incorporate temporal dependence into the models. One such approach uses duration variables suggested by Beck et al. (1988) (Beck et al., 1998: 1269). Timely dependence can be added to models using pooled data through duration variables.

5. Data and Variables

The study aims to investigate the impact of education levels and income inequality on female employment in Level-2 regions in Türkiye during 2018-2020 and identify spatial interactions related to employment rates. The data for the variables used in the study were obtained from the Turkish Statistical Institute (TÜİK, 2022a) database.

Table 3 lists the Level-2 regions used in the study.

Table: 3
Level-2 Regions

TR10	İstanbul	**TR71**	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
TR21	Tekirdağ, Edirne, Kırklareli	**TR72**	Kayseri, Sivas, Yozgat
TR22	Balıkesir, Çanakkale	**TR81**	Zonguldak, Karabük, Bartın
TR31	İzmir	**TR82**	Kastamonu, Çankırı, Sinop
TR32	Aydın, Denizli, Muğla	**TR83**	Samsun, Tokat, Çorum, Amasya
TR33	Manisa, Afyon, Kütahya, Uşak	**TR90**	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
TR41	Bursa, Eskişehir, Bilecik	**TRA1**	Erzurum, Erzincan, Bayburt
TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova	**TRA2**	Ağrı, Kars, Iğdır, Ardahan
TR51	Ankara	**TRB1**	Malatya, Elâzığ, Bingöl, Tunceli
TR52	Konya, Karaman	**TRB2**	Van, Muş, Bitlis, Hakkâri
TR61	Antalya, Isparta, Burdur	**TRC1**	Gaziantep, Adıyaman, Kilis
TR62	Adana, Mersin	**TRC2**	Şanlıurfa, Diyarbakır
TR63	Hatay, Kahramanmaraş, Osmaniye	**TRC3**	Mardin, Batman, Şırnak, Siirt

The dependent variable, female employment rates (Y_{WE}), was transformed into a qualitative variable using the median value as the threshold. The choice of the median value as the threshold effectively provides reliable results against variations in the dataset. The definition of the created dependent variable in this regard is presented in Equation 7.

$$Y_{WE} = 1, \text{ if the female employment rate in the region is above the median value} \quad (7)$$

$$Y_{WE} = 0, \text{ If the female employment rate in the region is below the median value}$$

The regions where the dependent variable takes the value of 1 represent areas with high female employment rates, while the regions where it takes 0 indicate areas with low female employment rates.

The explanatory variables included in the model are listed in Table 4.

Table: 4
Explanatory Variables Included in the Model

Variable Abbreviation	Variable Definition
Duration	Duration Variable
Ginicoef	Gini Coefficient as an Indicator of Income Inequality
Notgrad	Percentage of Literate Women Who Have not Completed Any School (% Ages 15-64)
Primarygrad	Percentage of Women with Elementary School Education (% Ages 15-64)
Secondarygrad	Percentage of Women with Secondary School Education (% Ages 15-64)
Universtygrad	Percentage of Women with University Education (% Ages 15-64)

In the study, a duration variable suggested by Beck et al. (1988) was employed to model the temporal dependence among observations. The duration variable, indicating the time elapsed since the female employment rates in regions surpassed the median value, was incorporated into the model using Philips' (2020) approach.

Table 5 provides descriptive statistics for the explanatory variables, excluding the duration variable in the model, to gain statistical insights into the data.

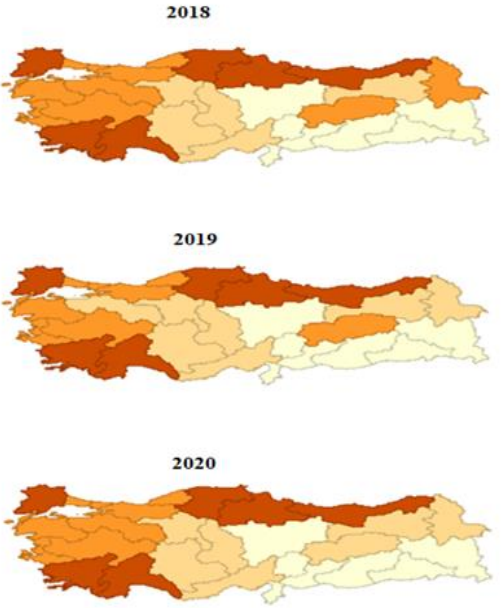
Table: 5
Descriptive Statistics

	Mean	Standard Deviation	Minimum Value	Maximum Value
Ginicoef	0,35	0,03	0,28	0,45
Notgrad	7,31	3,13	2,99	17,26
Primarygrad	24,42	5,26	12,65	34,13
Secondarygrad	16,15	3,97	10,02	26,66
Universtygrad	13,70	3,44	7,78	23,45

According to the 2018-2020 data from the Turkish Statistical Institute (TÜİK), the average Gini coefficient, an indicator of income inequality, is 0.35. The highest Gini coefficient is observed in the TR10 region in 2020, while the lowest value in the TR81 region in 2019. During the 2018-2020 period, the average percentage of literate women who have not completed any school within the female population in Türkiye was 7.31, while the average percentage of women with elementary school education was 24.42. The regions with the highest rates of literate women who have not completed any school and women with elementary school education are TRC2 (2018) and TR22 (2018), respectively, whereas the lowest rates are observed in TR51 (2020) and TRC3 (2020). Similarly, the average percentage of women with secondary school education is 16.15, while the average percentage of women with university education is 13.70. The regions with the highest rates of secondary school and university graduates are TRC3 (2020) and TR51 (2020), respectively, while the lowest rates are observed in TR82 (2018) and TRB2 (2018).

In spatial data analysis, the creation of quantile maps, which allows the detection of spatial clustering and facilitates data visualisation, provides researchers with more information about variable-related data. In this context, Figure 2 presents quantile maps created for female employment rates in 2018-2020.

Figure: 2
Spatial Distribution of Female Employment Rates



Source: Created by the authors.

In the quantile maps, regions shown in dark colour represent areas with the highest female employment rates (TR21, TR32, TR61, TR82, TR83, TR90), while light-coloured regions represent areas with the lowest rates (TRB2, TRC1, TRC2, TRC3, TR72, TR63). In this context, the gradient from dark to light indicates a decrease in the female employment rate.

6. Results

During this study's initial phase of the econometric analysis, the probability of the female employment rate exceeding the median value between 2018-2020 was estimated. This involved examining the effects of different education levels and income inequality using classical logit and probit models. In this regard, the estimated results of the models are presented in Table 6, and the marginal effects related to the coefficients are provided in Table 7.

Table: 6
Logit Model - Probit Model

Coefficients	Logit Model	Probit Model
Intercept	-34,2286** (13,8171)	-19,9121*** (7,6353)
Duration	-4,7686*** (1,6071)	-2,7041*** (0,8815)
Ginicoef	-30,6530** (13,7128)	-18,1347** (7,7649)
Notgrad	0,9637** (0,4214)	0,5530** (0,2293)
Primarygrad	0,7990*** (0,2584)	0,4645*** (0,1400)
Secondarygrad	0,4556* (0,2472)	0,2741* (0,1411)
Universtygrad	1,2723*** (0,3995)	0,7373*** (0,2167)
AIC Residual Deviance	47,209 33,209	46,622 32,622

*Note: ***, **, * indicate significance at 1%, 5%, and 10%, respectively.*

Table: 7
Marginal Effects

Coefficients	Logit Model	Probit Model
Duration	-0,3125	-0,3069
Ginicoef	-2,0091	-2,0585
Notgrad	0,0631	0,0627
Primarygrad	0,0523	0,0527
Secondarygrad	0,0298	0,0311
Universtygrad	0,0833	0,0836

When examining the estimation results of the classical logit and probit models, it is observed that all coefficients in both models are statistically significant. The negative coefficient of the duration variable is considered an expected outcome due to the decline in female employment rates between the relevant years. All education variables included in the model positively influence the probability of female employment rates above the median, while the Gini coefficient negatively impacts them. When examining the marginal effects, it is observed that among the education variables, the university graduate rate has the most significant positive impact on employment levels in both models, while the least influential education variable is the secondary school graduate rate. This finding supports the assertion by Uğur and Saraç (2019) that women with secondary education and similar levels of education face higher unemployment issues compared to less educated women, leading to lower employment rates (Uğur & Saraç, 2019: 12).

The results of the logit and probit models are observed to be quite close to each other. The literature states that unless the sample size is enormous, producing similar results with logit and probit models is an expected outcome. However, when a general comparison between logit and probit models is desired, AIC (Akaike Information Criterion) and residual deviance values can be used in line with the literature. These criteria should have small values for model prediction results. When examining Table 6, it can be stated that the probit model, which obtained smaller values for both criteria, provides better prediction results than the logit model.

As mentioned in the methodology section, investigating spatial effects in models is crucial for the reliability of model prediction results. When spatial effects are identified in the qualitative choice model, appropriate spatial econometric approaches are necessary for the statistical reliability of prediction results.

Table 8 presents the result of Moran's I test developed by Kelejian and Prucha (2001) to detect spatial dependence in the probit model of qualitative choice models.

Table: 8
Spatial Dependence Test

Test	Test Statistics
Moran's I $_{(KP)}$	1,7800*

*Note: ***, **, * indicate significance at 1%, 5%, and 10%, respectively.*

When examining the Moran's I test result, the null hypothesis of no spatial dependence is rejected, indicating the presence of spatial dependence in the model. Therefore, in the model where spatial dependence is detected, using approaches specific to spatial qualitative choice models is crucial for the reliability of the prediction results.

The literature considers choosing an appropriate spatial weight matrix a contentious issue. Hence, different neighbourhood criteria should be employed to create spatial weight matrices, and models should be estimated with these diverse spatial weight matrices (Gallo & Ertur, 2003: 177; Kubara & Kopczewska, 2024: 79).

The study created the spatial weight matrices using contiguity-based (queen neighbour criterion) and distance-based (k-nearest neighbour criterion) approaches. Standardised versions of the spatial weight matrices generated using these approaches were employed in the study. Tables 9 and 10 present the estimation results of the spatial logit and spatial probit models predicted through the LGMM method, one of the estimation methods of spatial qualitative choice models.

Table: 9
Estimation of SAR Logit Model with LGMM Method

Coefficients	Queen Criterion	k-Nearest Neighbors Criterion
Intercept	-41,8242** (18,5711)	-35,6109** (18,1413)
Duration	-8,5772*** (2,9410)	-7,8297** (3,2491)
Ginicoef	-58,0077*** (20,3514)	-57,3538*** (19,3080)
Notgrad	1,5978*** (0,5719)	1,5528*** (0,5655)
Primarygrad	0,9769** (0,4137)	0,8429** (0,3856)
Secondarygrad	0,8623** (0,3477)	0,8973*** (0,3420)
Universtygrad	1,7994*** (0,5996)	1,5041*** (0,5668)
Rho (ρ)	0,6751* (0,4091)	0,7178** (0,3193)

*Note: ***, **, * indicate significance at 1%, 5%, and 10%, respectively.*

Table: 10
Estimation of SAR Probit Model with LGMM Method

Coefficients	Queen Criterion	k-Nearest Neighbors Criterion
Intercept	-22,7477** (9,2063)	-21,3356** (9,2929)
Duration	-4,6986*** (1,3697)	-4,6388*** (1,4656)
Ginicoef	-29,9570*** (10,2618)	-31,6038*** (9,6589)
Notgrad	0,8314*** (0,2952)	0,8681*** (0,3025)
Primarygrad	0,5239*** (0,1899)	0,5011*** (0,1863)
Secondarygrad	0,5109*** (0,1752)	0,5320*** (0,1755)
Universtygrad	0,9332*** (0,2960)	0,8697*** (0,2800)
Rho (ρ)	0,6089** (0,1174)	0,6434*** (0,2458)

*Note: ***, **, * indicate significance at 1%, 5%, and 10%, respectively.*

When examining Tables 9 and 10, which include the estimation results of the spatial logit and spatial probit models predicted using the LGMM method, it is observed that all variables in the models are statistically significant. Additionally, all coefficient signs are the same as in the classical logit and probit models. The negative coefficient of the duration variable in both models suggests a decrease in the female employment rates in Level-2 regions during the 2018-2020 period.

The statistical significance of the spatial autocorrelation coefficient (ρ) in both spatial logit and spatial probit models using spatial weight matrices created with queen and nearest k neighbours criteria supports the result of Moran's I test, providing evidence of spatial dependence in the model. The positive sign of the coefficient ρ indicates the presence of positive spatial dependence. In line with the evidence of positive spatial dependence, an increase in the probability of female employment rates in neighbouring regions increases the likelihood of female employment rates in the respective area.

Although the prediction results of the models using the spatial weight matrices created with different neighbourhood criteria are similar, they are not identical. This is an expected outcome as model prediction results are sensitive to the choice of the spatial weight matrix. Moreover, the models estimated with both spatial weight matrices indicating positive spatial dependence provide information that the selected spatial weight matrices are appropriate for the respective model (Gallo & Ertur, 2003).

When estimating spatial qualitative choice models using the LGMM method, information about marginal effects on coefficients must be provided. Instead, interpretations of statistically significant coefficients are made based on their signs. In this context, similar to the results of classical qualitative choice models, spatial qualitative choice models observe that all levels of education, including the rate of those who have not completed any school, increase the likelihood of female employment rates being above the median value.

In addition to the positive impact of educational levels on the probability of female employment in the classical qualitative choice models, when examining the marginal effects of the coefficients, it is observed that the ratio representing those who can read and write but have not completed any school has a significant influence on the relevant probability, following university graduation rates. The variables indicating the rates of primary and secondary school graduates positively impact female employment, but compared to the other two variables, these effects are weaker. Uğur and Saraç (2019) state that the limited availability of job opportunities and lower qualifications and wages for existing jobs reduce women's employment rates with secondary education. On the other hand, women who can read and write but have not completed any school are generally considered part of the low-skilled labour force and often find themselves working under challenging conditions for low wages (Uğur & Saraç, 2019: 12; Aksoy, 2018: 98). This situation indicates that women with lower educational levels contribute positively to increasing the employment rate.

The findings regarding the impact of university graduation rates on female employment in the classical qualitative choice models support the studies of Özocaklı and Khanalizadeh (2023) and Güriş et al. (2019).

In addition to educational levels, another highly influential factor on female employment rates is the Gini coefficient, an indicator of income inequality. The fact that the Gini coefficient is the most influential variable among the considered variables not only demonstrates the undeniable impact of income inequality on female employment but also supports the idea, as stated in Aksu's (2022) study, that education alone is not the sole determinant of female employment rates.

The relevant finding regarding the Gini coefficient aligns with Sarı's (2022) and Özcan (2023) studies.

7. Conclusion

While economic growth in Türkiye is observed not to provide sufficient employment, this situation leads to the issue of growth that does not create employment, which is considered one of the most significant macroeconomic problems in the country. It is expected that practices aimed at increasing the female employment rate, which is one of the decisive factors for employment rates, and improving job opportunities will have a remedial effect on the issue of employment shortage, which is considered one of Türkiye's most critical macroeconomic problems. The current problems related to female employment were increasingly emphasised in the literature. The study explores the effects of different education levels and income inequality on female employment rates in Level-2 regions of Türkiye between 2018 and 2020. In this context, spatial qualitative choice models, which are noted to be still in the developmental stage in the literature, were utilised. In the study, where spatial logit and spatial probit models were estimated, a duration variable was included in the model to capture temporal dependence. The inclusion of spatial interactions for female employment rates in the literature had not been addressed with spatial qualitative

choice models. Additionally, incorporating a duration variable to account for time effects distinguishes this study from others.

In the initial stage of the spatial econometric analysis, the classical logit and classical probit models were estimated. The prediction results of the classical logit and probit models were similar, indicating that all educational levels increased female employment rates. However, it was observed that the duration variable and the Gini coefficient, an indicator of income inequality, had a decreasing effect on the relevant rates. Considering the goodness-of-fit measures, the findings suggest that the probit model outperforms the logit model in terms of prediction accuracy.

The Moran's I test proposed by Kelejian and Prucha (2001) within the scope of the probit model was used to detect spatial dependence among Level-2 regions, and the test results confirmed the presence of spatial dependence in the model. Following the identification of spatial dependence, the spatial logit and spatial probit models were estimated using the LGMM (Linearized Generalized Method of Moments) method developed by Klier and McMillen (2008).

The negative sign of the coefficient associated with the duration variable modelling the time effect in the models indicates a decrease in the female employment rates from 2018-2020. When examining the model prediction results, it was determined that the variable with the most significant impact on the probability of the female employment rate being above the median was the Gini coefficient. The strong negative effect of income inequality, considered a global issue, on female employment rates emphasises the importance of identifying effective policies to address income inequality. At this point, the significance of policies in reducing gender inequalities in labour markets becomes evident. It was found that different levels of education had a positive impact on female employment. The increase in employment rates associated with women who can read and write but have not completed any school highlights the need to improve the quality of female employment in Türkiye. Suppose gender inequality for women is reduced and equal educational and wage opportunities are provided. In that case, it is expected not only to increase employment rates but also to enhance the quality of employment.

The identified positive spatial dependence in duration variable spatial qualitative choice models indicates that the female employment rates in Level-2 regions are not independent. This result is expected to contribute to developing strategies and policies to improve female employment rates.

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