Journal of Tekirdag Agricultural Faculty
Tekirdağ Ziraat Fakültesi Dergisi

Mart/March 2024, 21(2)
Başvuru/Received: 28/03/23
Kabul/Accepted: 08/11/23
DOI: 10.33462/jotaf.1255108

http://dergipark.gov.tr/jotaf
http://jotaf.nku.edu.tr/

ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

The Relationship between International Migration, Agricultural Employment, and Household Labor Force in Türkiye*

Türkiye'de Dış Göç, Tarımsal İstihdam ve Hanehalkı İşgücü İlişkisi

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Abstract

There isn't much academic research on the impacts of immigration on the labor market and job structure at the national level, although Türkiye is one of the nation's hosting the greatest populations of refugees. Because of the scarcity of information, a research gap exists. As a result, the study was carried out to determine the impact of international migration on agricultural employment and the changes in agricultural employment in Türkiye. Johansen Co-integration and Granger Causality analyses were performed on data from 1988 to 2018 to evaluate the change in the agricultural workforce in Türkiye and to demonstrate the temporal influence of immigration. According to the findings of the cointegration study, a rise in emigration has a negative impact on the agricultural areas and agricultural employment while having a good impact on agricultural GDP. Migration has long-term detrimental consequences. According to the causality study, there is a one-way link between migration and agricultural GDP. A panel data analysis was performed to establish the short-term detrimental impact of migration on agricultural employment, as well as how the structure of employment altered and developed during this process. The statistics provide temporal data from 2004 to 2020, and the individual's agricultural employment status, education, income, continuous employment, and extra work status are cross-sectional data. According to the Panel Logistic Regression Analysis results, while more educated and higher income individuals leave away from the agricultural sector, the desire to have a side job leads the individual to the agricultural sector. International migration has a detrimental impact on agricultural employment and its structure in this scenario. As a result, the sustainability of the working arrangements established by immigration regulations should be assured, and limits and constraints should be implemented, particularly in the agricultural sector. When agricultural employees transition to other industries, agricultural areas are being used in ways that were not planned. As a result, in the long run, the decline in output may have a negative impact on agricultural GDP. This condition has been the topic of several research and may serve as the foundation for new ones.

Keywords: Agricultural employment, Immigration, Time series analysis, Panel data analysis

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Atıf: Sarıoğlu, T., Şengül H. (2024). Türkiye'de dış göç, tarımsal istihdam ve hanehalkı işgücü ilişkisi. *Tekirdağ Ziraat Fakültesi Dergisi,* 21(2): 348-361.
Citation: Sarıoğlu, T., Şengül H. (2024). Relationship between international migration, agricultural employment, and household labor force in Türkiye. *Journal of Tekirdag Agricultural Faculty,* 21(2): 348-361.

*This study was summarized from the Tuğçe Sarıoğlu's PhD thesis.

Öz

Türkiye, en büyük mülteci nüfusuna ev sahipliği yapan ülkelerden biri olmasına rağmen, dış göçün ulusal düzeyde işgücü piyasası ve istihdam yapısı üzerine etkileri konusunda fazla sayıda akademik çalışmanın olmadığı söylenebilir. Bu nedenle çalışma, uluslararası göçün Türkiye'de tarımsal istihdama etkisini ve tarımsal istihdam yapısında yaşanan değişimi ortaya koymak amacıyla yapılmıştır. Türkiye'de yaşanan tarımsal işgücündeki değişimi saptamak ve dış göçün zamansal etkisini ortaya koymak için, 1988-2018 dönemine ait verilerle Johansen Eşbütünleşme ve Granger Nedensellik analizleri yapılmıştır. Eşbütünleşme analizi sonucuna göre, kısa dönemde dış göç miktarındaki artış, tarım alanı miktarını ve tarımsal istihdamı olumsuz etkilerken, tarımsal gayrisafi yurtiçi hasılayı olumlu etkilemektedir. Uzun dönemde ise net göçün, tarımsal alan, tarımsal Gayrisafi Yurtiçi Hasıla ve tarımsal istihdam üzerine etkileri olumsuzdur. Nedensellik analizi sonucunda ise, göç ile tarımsal gayrisafi yurtiçi hasıla arasında tek yönlü bir ilişki bulunmuştur. Göçün kısa vadede tarımsal istihdama olumsuz etkisinin, bu süreç içerisinde istihdamdaki yapının nasıl değişiklik ve gelişim gösterdiğini saptamak için de panel veri analizi yapılmıştır. Panel verileri, 2004-2020 dönemi zaman verilerini, bireyin tarım çalışma durumu, eğitimi, geliri, işte sürekli çalışma ve ek iş yapma durumu ise kesit verilerini oluşturmaktadır. Yapılan Panel Logistik Regresyon Analizi sonucuna göre ise, eğitim düzeyi ve geliri artan birey tarım sektöründen uzaklaşırken, bireyin ek iş yapma isteği kişiyi tarım sektörüne yönlendirmektedir. Bu durumda uluslararası göçün tarımsal istihdamı ve yapısını olumsuz yönde etkilemektedir. Bu nedenle göçmen politikalarında yapılan çalışma düzenlemelerinin sürdürebilirliği sağlanmalıdır. Tarımda çalışmaktan vazgeçen işçilerin farklı sektörlere yönelmesiyle birlikte tarım alanlarının amaç dışı kullanımı söz konusu olmaktadır. Böylece uzun dönemde üretim miktarındaki azalış ve bunun sonucunda da tarımsal GSYİH'yi de olumsuz etkileyebilir. Bu durum farklı çalışmaların konusudur ve yeni çalışmalara altyapı oluşturabilir.

Anahtar Kelimeler: Tarımsal istihdam, Dış göç, Zaman serisi, Panel veri analizi

1. Introduction

Unemployment and employment issues are a social and economic problem that countries face. This issue is not only limited to developing countries, but also affects developed countries. Employment is an important priority in economic policies in all countries. Like any developing economy, structural changes, globalization, modernization, and industrialization processes in a country affect the distribution of employment across sectors.

The widespread technological development and mechanization contribute to the advancement while reducing the importance of the agricultural labor force, leading to unemployment in the sector. This situation narrows down employment in the agricultural sector while increasing the orientation towards other sectors. In particular, the expansion of the service sector also reveals structural unemployment (Zagler, 2009). In Türkiye, while the agricultural sector constituted 46.5% of the total employment in 1988, it decreased to 17.6% in 2020. Although this situation is desirable for the country's level of development, the employment in the agricultural sector has been forced to transition to different sectors (56.2% service sector) (Anonymous, 2021b). In 1988, Türkiye had 24.7 million hectares of cultivable land out of 39 million hectares of agricultural land, while in 2020, it had 19.5 million hectares of cultivable land out of 37.7 million hectares of agricultural land (Anonymous, 2022). There has been a decrease of 3% in agricultural land and 21% in cultivable land. This decrease highlights the usage costs of family labor, permanent and seasonal workers. In this case, the choice between seasonal and permanent labor is not only made for the seasonality of the activity but also to reduce the costs. However, studies have shown that family labor replaces paid labor (Darpeix et al., 2014). In rural areas, women exhibit a high level of labor intensity in production. In rural settings, women and young girls are in unpaid family labor positions and simultaneously carry a significant workload (Fazlıoğlu, 2002; Yılmaz et al., 2019).

In Türkiye, the active population aged 15-64 constitutes 67.7% of the total population, which amounts to 56 million people as of 2020. Among the active population, 43% are not part of the workforce, leaving 30.1 million potential workforce members, out of which 26.8 million are employed. The unemployment rate in Türkiye is 13.4%, and the non-agricultural unemployment rate is 15.4% (Anonymous, 2020a). According to a report published by the International Labor Organization in 2015, the period from 2015 to 2020 was predicted to be a period of slow growth, increasing inequality, and rising unemployment globally (Pınar et al., 2016). During the period of global unemployment increase, Türkiye faced massive international migration. The uncontrolled integration of refugees into the Turkish labor market has increased the importance of unemployment policies. Unplanned and uncontrolled external migration has affected not only other sectors but also the agricultural sector. Refugees who migrated have moved towards the agriculture sector, where unskilled labor is abundant and labor productivity is low. As a result, refugee workers in agriculture accept lower wages. Consequently, employers who find local labor costs high tend to prefer foreign labor, which leads to a substitutability relationship between local and refugee labor. In this situation, agricultural employees do not want to be involved in agricultural production activities, and their propensity to migrate to urban regions will increase as a result of the changing working environment. A rise in structural unemployment will be caused by the phenomenon of mobility within the rural labor force and its participation in other industries as unskilled labor, a decline in socioeconomic welfare, and unplanned urbanization (Karakayacı et al., 2022)

There are numerous studies examining the relationships between external migration, unemployment, employment, and GDP. This text provides a review of studies examining the relationship between migration and unemployment. Various studies conducted using different methods in different countries have reached different conclusions on the impact of an increase in immigrant workforce on the employment opportunities of native workers, with some suggesting that it leads to increased unemployment (Verturini and Villisio, 2004; Latif, 2015; Nurdoğan and Şahin 2019; Engin and Konuk, 2020; Meçik and Koyuncu, 2020; İşcan and Demirel, 2021; Ergün and Polat, 2022), while others have not found a significant relationship between migration and unemployment (Shan et al., 1999; Islam, 2007; Boubtane et al., 2011; Altunç et al., 2017). Additionally, studies have been conducted that suggest that migration can either reduce unemployment (Esposito et Al., 2020; Gülbahar, 2020) or be a cause of it (Feridun, 2004; Chletsos and Roupakias, 2012).

Regarding the relationship between international migration and Gross Domestic Product (GDP), some studies have found a positive impact of migration on GDP (Felbermayr et al., 2010; Boubtane et al., 2013; Ortega and Peri, 2014; Engin and Konuk, 2020; Gülbahar, 2020), while others report a negative impact (Ahmed, 2010; Sevinç and Sevinç Eroğlu, 2016; Şimşek, 2018). Studies examining the direction of causality between migration and GDP have distinguished between one-way causality, with GDP being the cause of migration (Morley, 2006) or migration being the cause of GDP (Göv and Dürrü, 2017; Şimşek, 2018; Meçik and Koyuncu, 2020) and bidirectional causality (Feridun, 2004; Altunç et al., 2017).

This study focuses on the impact of international migration on agricultural employment in Türkiye. Changes in the structure of agricultural employment in Türkiye have been analyzed at the household level, and the employment status of individuals has been examined. In this way, variables are selected from agricultural data to examine the impact of external migration specifically within the agricultural sector and to observe its effects on families engaged in agriculture in both the long and short term. What sets this study apart from others is the absence of similarly specific research within the agricultural sector.

2. Material and Method

2.1. Material

In the study, firstly, the relationship and direction between net external migration, employment in agriculture, agricultural land, and agricultural Gross Domestic Product (GDP) in Türkiye were investigated using time series data for the period 1988-2018 obtained from TSI, Presidency of The Republic of Türkiye Strategy and Budget Directorate, FAO, and relevant articles. In the second part of the study, selected factors affecting agricultural employment in Türkiye were examined with time effects. In this section, education, income, job continuity status, and additional job variables were used for panel data, and the micro-data set of "TSI Household Labor Force Surveys" between 2004-2020 was used. This data set consists of households randomly selected to represent Türkiye each year. Due to the differences in the structure of the survey questions, sample size, and frequency of application over the years (Anonymous, 2021a), the use of 2004 and subsequent years was deemed appropriate. Additionally, analyses were conducted on fundamental questions that did not change over 17 years due to changes in the questions.

2.2. Time Series Analysis

The study employed a time series analysis using annual data from 1988 to 2018 with the aim of determining the effects of time-varying events, drawing inferences, establishing causal and meaningful relationships. The variables utilized in the study consisted of net outward migration, agricultural land, agricultural gross domestic product (GDP) and agricultural employment data. The model employed in the analysis was constructed with the aim of determining the long- and short-term effects of the variables. In order to utilize the variables together in the analysis, they must be at the same stationary level. Therefore, the stationarity of the variables was tested by using the Augmented Dickey Fuller (ADF) unit root test and the difference stationary test (Fuller, 1976; Dickey and Fuller, 1979).

Johansen Cointegration Analysis: The Johansen method is a test that estimates the cointegration vector using the Maximum Likelihood method. The Johansen method is a generalized form of the Dickey-Fuller method. In the Johansen multiple cointegration model, a vector autoregressive (VAR) model is considered. In practice, although there are many tests that investigate long-term relationships, the Johansen Cointegration test is a commonly used test (Bozkurt, 2013). The main reason for choosing the Johansen cointegration analysis is that the variables in the model have the same lag length and are I (1) and/or cointegrated. A vector autoregressive model (VAR) is used to identify short-term relationships between variables.

Granger Causality Test: In this study, the Granger Causality test is used to examine the direction and existence of the causal relationship between time series. This test allows both the hypothesis of whether variables cause each other and whether there is instantaneous causality between variables to be tested. Granger causality analysis, developed by Granger (1969), is one of the most preferred methods due to its ease of applicability (Karaca, 2003). In practice, to detect causality between two variables, the deterministic elements of these variables should be removed first. In economics, variable series are generally not stationary because they reflect the effect of trend and/or seasonal components. When the series are purified from these effects, covariance stationarity is achieved (Granger, 1969).

Tablo 1. Data of variables

Abbreviations	Description/units of variables	References
AGREMP	Agricultural employment (1000 people)	Anonymous, 2020b
NETMIGR	International net migration (1000 people)	Altunç et. al, 2017, Anonymous, 2020a
AGRLAND	Agricultural field (1000 ha)	Anonymous ,2020c.
AGRGDP	Agricultural Gross Domestic Product (million $)	Anonymous, 2019

The abbreviations used for the study variables were explained in *Table 1*. Net international migration was estimated to be the function of agricultural land, agricultural employment and agricultural gross domestic product as given in Eq.1 and Eq 2.

$$\mathrm{NETMIGR} = \mathrm{f}\,(\mathrm{AGREMP}, \mathrm{AGRLAND}, \mathrm{AGRGDP}\,) \qquad \text{(Eq.1)}$$

Model;

$$\mathrm{NETMIGR} = \mathrm{a} + \beta_1 \mathrm{AGREMP_t} + \beta_2 \mathrm{AGRLAND_t} + +\beta_3 \mathrm{AGRGDP_t} + \mathrm{e_t} \qquad \text{(Eq.2)}$$

$\mathrm{e_t}$ = error term, $\mathrm{t} = 1988, 1991, 1992, \ldots, 2018$ created in the form.

2.3. Panel Data Analysis

In the study, while investigating the effects of migration on agriculture with macro variables, panel logistic data analysis was conducted to explain the effects of selected factors on agricultural employment at the micro level using household data. A panel data set was created by using selected variables (education, job continuity status, income, and having an additional job) from the 'Household Labor Force Surveys' created by TURKSTAT between 2004-2020. Thus, both the relationship between variables explaining the structure of families working in agriculture and the relationship with time were examined together. Panel data can be defined as the combination of cross-sectional observations over a certain time period (Baltagi, 2005). Panel logit data analysis can be used when the dependent variable shows qualitative characteristics by taking the value 1 in case of an event and 0 if it does not occur. Models where the dependent variable is binary are referred to as binary qualitative choice models. There is no constraint on explanatory variables. Explanatory variables can be in different data types, i.e., nominal, ordinal, interval, ratio, integer, continuous (Akay, 2015). The variables used in the study were as follows: dependent variable was agricultural workers: 0, non-agricultural sector workers: 1; explanatory variables were education, continuity status (continuous worker: 1, temporary/seasonal worker: 2), having an additional job (yes: 1, no: 2), and income, which was coded as a continuous variable (*Table 2*).

Tablo 2. Descriptive statistics of variables

Variables	Analysis Code	Total number of observations (ods)	Mean	Std Dev	Min-Max
Activity	Agriculture:0 Non-agricultural:1	1.020.00	0.5637	0.4959	0-1
Education	1-6*	1.020.00	3.5907	1.8801	1-6
Continuity	Permanent:1 Temporary:2	662.826	1.1110	0.3141	1-2
Additional job	Yes:1 No:2	1.020.00	1.9107	0.2850	1-2
Income	Continuous data	971.910	1431.666	1985.088	0-200.000

*Non-Graduate: 1, Primary School: 2, Lower Secondary Education (8 years): 3, General High School: 4, Vocational High School: 5, College and Above: 6

The HHI (Herfindahl-Hirschman Index of Attraction) only reflects the number of employed individuals. Over the years, variations in employment numbers have created an unbalanced panel data set. To transform this unbalanced data set into a balanced one, we initially selected the year with the lowest number of surveys, reducing the count in other years to 136,902 individuals. During this reduction process, priority was given to those with missing data in the explanatory variables. The total data count was reduced from 2,715,387 individuals to 2,327,334 individuals. To accommodate the data within Excel's limit of 1,048,576 rows, it was reorganized to reach a total of 1,020,000 rows."

Fixed-effects panel logit models: Models in which it is assumed that the coefficients vary by units or by units and time, and which allow the unobserved heterogeneity to be related to the explanatory variables. In fixed-effects panel logit models, estimations are mostly made by the maximum likelihood method. The maximum likelihood method is based on maximizing the logarithmic similarity. The logarithmic similarity function,

$$L(\mu, \boldsymbol{\beta}) = \sum_{i=1}^{N} \sum_{t=1}^{T} \log\left[1 + e^{(\mu i + \beta x x_{it})}\right] + \sum_{i=1}^{N} \sum_{t=1}^{T} y_{it}(\,(\mu i + \beta x_{it}) \qquad \text{(Eq.3)}$$

is obtained in the form (Hsiao, 1996; Akay, 2015). In Equation 3, inconsistency occurs in estimating the coefficient representing the unit effect (τi) when the time value (T) is small and the unit value (N) is large. Andersan's (1970) suggested method involves estimating the structural parameters (**β**). In fixed effects panel logit models, a z-test is performed for the individual significance of the coefficients, and an LR test is used to test the joint significance of the estimators. When the maximum likelihood estimator is used, iteration can be used to estimate nonlinear parameters. The iteration methods used are the Newton-Raphson and scoring methods (Long, 1997; Maddala, 2001; Demirhan, 2019). The regression equation to be used in the study is shown in Equation 4.

$$activity = a + \beta_1 education_t + \beta_2 continuity + \beta_3 addjob + \beta_4 income + u_{it} \qquad \text{(Eq.4)}$$

$$ti = 1, \ldots, 60.000;\; t = 1, \ldots., 17 \;\; (2004, \ldots, 2020)$$

Among the analyzes performed in the study, F test, LR test, Hausman tests and fixed or random effects model were used to decide whether to use. As a result of this test, Fixed Effect Panel Logit Model analysis was deemed appropriate. The purpose of using this model is to allow unobservable heterogeneity to be related to the explanatory variables, thus enabling the explanation of unit-specific effects with a fixed coefficient. However, household size, number of household workers, and rural-urban distinction are unobservable factors that affect agricultural employment, and the unit fixed effect has not been considered in this study. In real panel data, this effect can be easily taken into account. However, the dataset used in this study is not a real panel dataset. Data is collected from randomly selected households each year, and it is not possible to track households over time (Öztornacı, 2019).

A yearly dataset covering the period of 2004-2020 has been created using the Household Labor Force Survey data set prepared by the Turkish Statistical Institute (TSI). Firstly, a regression model was constructed for the variables, and after necessary model checks, a panel logit model was applied to the variables. Following the estimation of the model, differential rates and marginal effects analysis were conducted to interpret the coefficients. The basic hypothesis used in the analysis was:

H_0= Employment in agriculture is not associated with education, the presence of secondary employment, income, and job continuity.

H_1= Employment in agriculture is associated with education, the presence of secondary employment, income, and job continuity

3. Results and Discussion

3.1. Time Series Analysis Results

This study aims to investigate the relationships between variables using annual data from 1988 to 2018 in Türkiye. Firstly, the general trends of the variables are demonstrated during the specified period, followed by conducting unit root tests on the variables. Prior to applying unit root tests on the variables, the graph indicating whether they are stationary at levels or not is shown in *Figure 1*.

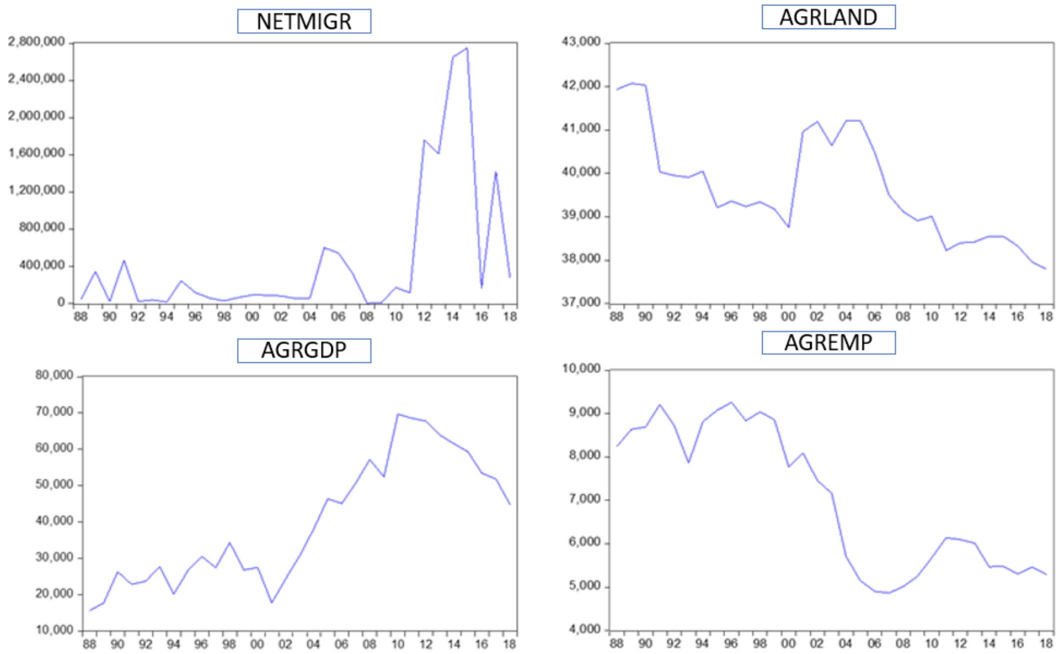

Figure 1. Level value graphs of variables

Upon examining the graphs of the variables presented in *Figure 1*, it can be observed that the variables are not stationary and exhibit an increasing or decreasing trend. In order to test the stationarity of the variables, the Augmented Dickey-Fuller (ADF) unit root test was employed. The ADF unit root test results for the variables are presented in *Table 3*, which investigates the stationarity of the variables.

Table 3. ADF unit root test results of variables

Variables	Level		1st difference	
	t	Prob	t test	P
NETMIGR	1.243948	0.9413	-4.805554	0.00000
AGRLAND	-1.199369	0.2056	-5.192305	0.00000
AGRGDP	0.208255	0.7398	-5.908197	0.00000
AGREMP	-1.188335	0.2092	-4.677331	0.00000

The test results indicate that the variables are non-stationary at the level I(0), with significance level of $p < 0.05$ and critical values exceeding the 1%, 5% and 10% levels, implying that they are non-stationary at the unit root level. Therefore, when the first differences of the variables are taken, the significance level remains below $p < 0.05$ and below the t-statistic values of 1%, 5%, and 10%. This suggests that the first differences of the values are stationary, and that the series do not have a unit root (*Table 3*). Consequently, the first differences of the variables being stationary implies that they are integrated of order one, I(1), and suitable for cointegration tests. The selection of the appropriate model for the analysis was determined based on the Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC) results, which suggested the use of a model without a constant and trend. The stationary first differences of the variables are suitable for Johansen Cointegration Analysis (JEA). A Vector Autoregressive (VAR) model was constructed to determine the long-term relationship between the variables, with a lag order of (1 1). The test results for the roots of the VAR model show that all the roots are less than 1 and lie within the circle. After conducting a root test, the results of the JEA's trace test and maximum eigenvalue test are presented in *Table 4*.

The hypothesis tested in the JEA test is H_0: There is no cointegration among the series and H_1: There is cointegration among the series. According to the results presented in *Table 4*, since the Trace statistic and the Maximum Eigenvalue statistic are greater than the table value at the 5% significance level, the null hypothesis H0 is rejected and the alternative hypothesis that there is at most one cointegrating relationship is accepted. Therefore, it is concluded that the series move together in the long run, and there is cointegration among the variables in the long run, indicating that the series are balanced. Based on these results, there is cointegration among net external migration, agricultural land, agricultural employment, and agricultural GDP. To determine the deviations that occur in the long run and how many periods it takes for them to return to equilibrium, an error correction model (ECM) is established, and the results are shown in *Table 5*.

Table 4. Trace and Max-Eigen test results

Hypothesized No. of CE(s)	Trace Statistic**	0.05 Critical value	Prob	Max-Eigen Statistic**	0.05 Critical value	Prob
r=0*	54.5576	47.85613	0.0103	27.61699	27.58434	0.0495
r≤ 1	26.94057	29.79707	0.1031	17.56414	21.13162	0.147
r≤ 2	9.376427	15.49471	0.3317	8.202283	14.2646	0.3585
r≤ 3	1.174145	3.841466	0.2786	1.174145	3.841466	0.2786
r≤ 4	54.5576	47.85613	0.0103	27.61699	27.58434	0.0495

** indicates rejection of the hypothesis at 0.05 level.** Trace test shows 1 cointegration equivalent(s) at 0.05 level, Max-eigenvalue test shows 1 cointegration equation at 0.05 level.*

Table 5. Error correction model (ECM) results

Short Term ECM	D(NETMIGR)	D(AGRLAND)	D(AGRGDP)	D(AGREMP)
CointEq1	-0.599595	0.000253	-0.003344	8.89E-05
Standard Error	0.13562	0.00017	0.00163	0.00014
T istatistic.	-4.42128	1.52997	-2.04897	0.62969
Long Term ECM	**D(NETMIGR)**	**D(AGRLAND)**	**D(AGRGDP)**	**D(AGREMP)**
CointEq1	1.000	-852.5913	-103.0856	-482.2311
Standard Error	--	183.148	19.9061	160.808
T istatistic.	--	-4.65521	-5.17858	-2.99880

The results of the long-term and short-term error correction models are presented in *Table 4*. In order for the CointEq1 value (error correction coefficient) to be significant, it is necessary for the calculated t-value to exceed the absolute value of 2 at the 5% significance level (Tari, 2012; Altunç et. Al, 2017), and fall within the range of 0 to -1. In the short term, the error correction coefficient is significant for the variables NETMIGR and TARGDP based on the t-test statistic. According to the model used, short-term fluctuations will approach long-term trends in approximately 1.7 years, as calculated based on the formula 1/|ECM|=1/|-0.599595|. Moreover, in the short term, an increase in net migration has a negative impact on agricultural land and employment, while positively affecting economic growth. In the long term, however, an increase in net migration results in a decrease in agricultural land, agricultural GDP, and agricultural employment. However, since the error correction coefficient is not within the range of 0 to -1 in the long term, no statistically significant relationship can be detected.

According to the findings of the study, the increase in international migration has a negative impact on agricultural employment, which suggests that immigrant workers may displace native workers. Analysis of 3-month data from Italy for the period of 1993-97 shows that the increase in immigrant labor limits the work opportunities of native workers (Verturini and Villisio, 2004), while a study conducted in Canada found that the short-term increase in migration rates increases unemployment (Latif, 2015). In a study conducted on migration, unemployment, and poverty in Nigeria, it was concluded that migration increases unemployment (Ogu, 2022). Similar to studies conducted in Türkiye, studies show that the increase in migration rates also increases unemployment (Engin and Konuk, 2020). On the other hand, a study showed that a 10% increase in migration stock increased per capita GDP by 2.2% (Felbermayr et al., 2010), and a 1% increase in migration increased per capita GDP by 6% (Ortega and Peri, 2014). Boubtane et al. (2013) found that international migration positively affects the GDP of the receiving country, while studies conducted in Türkiye showed that the increase in migration rates also increases economic growth (Engin and Konuk, 2020; Gülbahar, 2020, İşcan and Demirel, 2021). According to the findings of this study, although the short-term increase in the number of international immigrants has positive effects in the short term, this shock loses its effect within 1.7 years and negatively affects GDP in the long term. The reason for this negative effect on GDP is the unskilled nature of the incoming immigrants. The notion that skilled immigrants reduce the negative impact on GDP is supported by studies such as Dolado et al. (1994) and Barro and Sala-i-Martin (2004). The findings of Ahmed (2010), Sevinç and Sevinç Eroğlu. (2016), and Şimşek (2018) are consistent with the conclusion that an increase in the number of immigrants negatively affects GDP.

According to the Johansen cointegration analysis, a relationship has been identified between the variables, with at least one variable showing a relationship. While cointegration analysis indicates the presence of a relationship between variables, it does not determine the direction of the relationship. Therefore, the Granger Causality test is used to determine the direction of the relationship. As this test indicates the direction of the relationship between two variables, hypotheses are established separately. The necessary hypotheses and their results for applying this test are presented in *Table 6*.

Table 6.Granger Causality Test results

Causality	Null Hypothesis:	P-value	Decision
NETMIGR→AGRLAND	H_0: NETMIGR does not Granger Cause AGRLAND	0.6209	Do not reject
NETMIGR→AGRGDP	H_0: NETMIGR does not Granger Cause AGRGDP.	**0.0025***	Reject
NETMIGR→AGREMP	H_0: NETMIGR does not Granger Cause AGREMP.	0.0734	Do not reject
AGRLAND→NETMIGR	H_0: AGRLAND does not Granger Cause NETMIGR.	0.8586	Do not reject
AGRLAND→AGRGDP	H_0: AGRLAND does not Granger Cause AGRGDP.	0.7675	Do not reject
AGRLAND→AGREMP	H_0: AGRLAND does not Granger Cause AGREMP	0.1780	Do not reject
AGRGDP→NETMIGR	H_0: AGRGDP does not Granger Cause NETMIGR	0.8389	Do not reject
AGRGDP→AGRLAND	H_0: AGRGDP does not Granger Cause AGRLAND	0.8826	Do not reject
AGRGDP→AGREMP	H_0: AGRGDP does not Granger Cause AGREMP.	0.6828	Do not reject
AGREMP→NETMIGR	H_0: AGREMP does not Granger Cause NETMIGR.	0.5141	Do not reject
AGREMP→AGRLAND	H_0: AGREMP does not Granger Cause AGRLAND.	0.8915	Do not reject
AGREMP→AGRGDP	H_0: AGREMP does not Granger Cause AGRGDP	0.6209	Do not reject

According to the results of the Granger causality test presented in *Table 5*, if the probability value is greater than 0.05, H0 is accepted, and if it is less than 0.05, H0 is rejected. The study finds that migration causes agricultural GDP, but agricultural GDP does not cause migration. Therefore, there is a one-way relationship between migration and agricultural GDP. In studies conducted on 7 OECD countries (Australia, France, Germany, Italy, UK, USA) (Gov and Durru, 2017) and the 8 countries with the highest migration (USA, UK, Australia, France, Canada, Germany, Netherlands, and Japan) (Simsek, 2018), it was concluded that there is a one-way relationship between migration and per capita GDP. This relationship suggests that countries intending to receive migrants should consider their demographic structures and selective nature of the migrants who can add value to the country. Considering that the OECD countries in this study are developed countries and have not been subjected to sudden, massive, and involuntary migration like Türkiye, similar results are obtained indicating that migration is an important variable for economic growth. In studies conducted in Türkiye, it wasfound that there was one-way causality relationship between migration and GDP, which is similar to the results of the studies by Mecik and Koyuncu (2020) and Iscan and Demirel (2021). However, studies by Feridun (2004), Altunc et al. (2017), Boubtane et al. (2013) and Adiele and Umezuruike (2021) on the bi-directional causality between international migration and GDP show different results.

3.2. Panel Logistics Data Analysis

The period from 2004 to 2020 witnessed an increase in the educational levels of those employed in agriculture, and as educational levels rise, the employment rate in the non-agricultural sector also increases. One of the most significant factors that can explain employment in both agriculture and non-agricultural sectors is household income status. Additionally, whether the employed individual works permanently or on a temporary/seasonal basis, as well as their engagement in additional work, also has an impact. Therefore, the regression model can be represented as follows (Eq. 5):

$$activitiy = \beta_0 + \beta_1 education + \beta_2 continutiy + \beta_3 addjob + \beta_4 income + u_{it} \quad (Eq.5)$$

The output of the panel regression model is presented in *Table 7*. The F-test probability value of Prob>F=0.00 indicates that the test statistic is significant. The R-squared 0.51 and adjusted R-squared values are 0.48, indicating that the variables in the model explain 48% of the variance in the dependent variable. When the significance level of α=0.05 is used, the coefficients of the explanatory variables are statistically significant as $p<\alpha$. The coefficients of the variables show that having additional work and a lack of continuity in employment have a negative effect on the dependent variable of employment status, indicating that an increase in these two variables has an adverse effect on working in agriculture.

Table 7. Pooled Least Squares

Independent variable	Coefficients	Standard Error	t-istatistic.	P>|t|
Income	0.0815709	0.0002252	362.23	0.000
Education status	-0.4294411	0.0011547	-371.90	0.000
Continuity status	-0.2405996	0.0012278	-195.96	0.000
Additional job status	0.0000239	1.77e-07	134.59	0.000
Constant	1.366765	0.0028742	475.52	0.000

Decision tests are applied among estimators in order to perform panel logit data analysis. The validity of classical models in panel data models is tested by F test and likelihood ratio test. In order to test whether the constructed regression model is a classical model, the hypotheses of the F test are:

H_0= Unit effects are equal to zero (Classical model)
H_1= Unit effects are not equal to zero (Fixed or random effects model)
H_0= Time effects are equal to zero (Classical model)
H_1= Time effects are not equal to zero (Fixed or random effects model)

The null hypothesis assumes that the estimated coefficients for each section are zero, while the alternative hypothesis assumes that the estimated coefficients for each section are different from zero. The results of the test are presented in *Table 8*. When the test statistic F is compared with the F distribution table with degrees of freedom, Prob>F = 0.00 is significant. Assuming a significance level of alpha=0.05, since p<alpha, the null hypothesis is rejected, and the alternative hypothesis is accepted, indicating that both unit and time effects exist.

Table 8. F test results of the model according to cross-section and time

Group variable	F test	Sd1	Sd2	P
Cross-section (id)	108.77	59999	602822	0.0000
Time (year)	139432.58	16	662805	0.0000

Likelihood Ratio Test (LR Test): This test examines the classical model against the random effects model. The hypothesis for the LR test statistic to test the presence of unit and time effects is as follows:

H_0 = Standard errors of unit effects are equal to zero. (Classical model)
H_1 = Standard errors of unit effects are not equal to zero. (Random effects model)
H_0 = Standard errors of time effects are equal to zero. (Classical model)
H_1 = Standard errors of time effects are not equal to zero. (Random effects model)

Based on the analysis conducted for the presence of unit and time effects, the probability of chisquare > chibar2 is 0.00, which is significant when compared with the X2 distribution table. Taking the significance level as α = 0.05, since $p < \alpha$, the null hypothesis is rejected, and the alternative hypothesis is accepted. Therefore, it is concluded that the standard errors of time and unit effects are not equal to zero. (*Table 9*).

In conclusion, the F-test and LR-test results indicate that the model is not a classical model. The analyses were conducted for both unit effects and time effects, and it was observed that both effects exist in the model. Therefore, depending on how unit or time effects are included in the model, different models are created. These models are fixed and random effects models. In the fixed effects model, the effects belonging to the units are expressed with fixed coefficients, while in the random effects model, the effects that occur according to the unit and time are included in the model as a random error term. Therefore, a Hausman test is performed to choose between fixed and random effects models.

H_0: The explanatory variables in the unit effects model are uncorrelated. (Random effects model)
H_1: The explanatory variables in the unit effects model are correlated. (Fixed effects model)
H_0: The explanatory variables in the time effects model are uncorrelated. (Random effects model)
H_1: The explanatory variables in the time effects model are correlated. (Fixed effects model).

Table 9. LR test results of the model according to cross-section and time

Group variable	**LR**	**Chi2**	**P**
Cross-section (id)	717302.13	1.2e+06	0.0000
Group variable	**Wlad**	**Chi2**	**P**
Time (year)	557753.06	80510.72	0.0000

According to the results of the Hausman test (*Figure 2*), the Prob> chibar2 value was found to be 0.00. Based on the test statistic, the null hypothesis (H_0) was rejected, indicating that the random effects estimator is inconsistent and the fixed effects estimator is valid. The model was also tested for time effects, and the same conclusion was reached.

	(b) re	(B) fe	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
eğitim	.0137577	.008195	.0055627	.0000548
sureklilik	-.0673915	-.0470198	-.0203717	.0002875
ekiş	-.669	-.6932335	.0242336	.0004156
Gelir	.0000131	.0000111	2.04e-06	4.49e-08

```
            b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

          chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                  =    28263.62
        Prob>chi2 =      0.0000
```

	(b) re	(B) fe	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
eğitim	.0680153	.0680003	.000015	1.72e-06
sureklilik	-.4385198	-.4385114	-8.34e-06	8.50e-06
ekiş	-.2299675	-.2299766	9.09e-06	8.46e-06
Gelir	.0000287	.0000288	-1.89e-08	.

```
            b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

          chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                  =       81.11
        Prob>chi2 =      0.0000
        (V_b-V_B is not positive definite)
```

Figure 2. Level value graphs of variables

Therefore, it was decided that the appropriate model for this study is the fixed effects panel logit model. The basic hypothesis to be tested in this study is presented as follows:

H_0: Employment in agriculture is not related to education, the presence of additional work, income, and job continuity.
H_1: Employment in agriculture is related to education, the presence of additional work, income, and job continuity.

When examining the estimated model, it was found that the coefficients of the panel logit model are significant at significance level of 5%. The model is statistically significant at a 0.05 error margin based on the highest similarity (LR) test result, with prob> chi2: 0.000. Therefore, the model is significant, and it can be concluded that employment in agriculture is related to education, the presence of additional work, income, and job continuity. The coefficients of the explanatory variables in the estimated model are presented in *Table 10*.

Table 10. Fixed effect panel logit model results

Independent variable	**Coefficients**	**Standard Error**	**Z ist.**	**P>|z|**
Education	0.302195	0.0356723	8.46	0.000
Continuity	-0.2619375	0.0874818	-2.99	0.003
Add.job	-13.27086	0.5968429	-22.24	0.000
Income	0.0022257	0.0000761	29.26	0.000

The Fixed Effects Panel Logit Model equation has been derived;

$$Y = 0.302195X_{education} - 0.2619375X_{continuity} - 13.27086X_{addjob} + 0.0022257X_{income} \quad \text{(Eq.6)}$$

as presented in Equation 6. The explanatory variables in the model, namely supplementary work and job continuity, have negative effects, whereas income and education have positive effects (*Table 10*). Thus, individuals with higher education and income tend to be less likely to work in the agricultural sector. Furthermore, the desire for job continuity motivates individuals to work in the agricultural sector. Finally, the desire to engage in supplementary work leads individuals to work in the agricultural sector. As no similar study was found in the literature that uses the same method and variables, the results cannot be compared with those of other studies.

4. Conclusion

This study aims to explain the net migration-agriculture relationship in Turkey between 1988 and 2018 using macro-level variables. In the short term, an increase in net migration has a negative impact on agricultural land and employment but positively affects economic growth. However, in the long term, an increase in net migration adversely affects agricultural GDP, a relationship parallel to the results of causality tests. Panel data analysis indicates that individuals with higher education and income levels tend to move away from the agricultural sector, explaining structural changes in the agricultural sector. Recent trends, including an increase in the education level of those employed in agriculture and the influx of unskilled foreign labour, have accelerated the shift away from the agricultural sector. As workers abandon agriculture for other sectors, there is a risk of agricultural land being used for non-agricultural purposes, which could lead to a long-term decrease in production and negatively impact agricultural GDP. This situation has been the focus of various studies and could serve as a basis for further research. Limited data access and changes in survey questions over intervals in household surveys have constrained the formation of time series data, preventing data comparisons. This study, being the first in panel data analysis within the agricultural sector, serves as a reference for future research.

Acknowledgment

This study was supported by the Research Project No. 12804 of Çukurova University. We would like to thank TSI for contributing to the realization of the study. We would also like to thank the referees for their efforts.

Ethical Statement

There is no need to obtain permission from the ethics committee for this study.

Conflicts of Interest

We declare that there is no conflict of interest between us as the article authors.

Authorship Contribution Statement

The study was conducted within the scope of a PhD thesis, and its planning, examination, evaluation, and finalization processes were carried out by Prof. Dr. Haydar Şengül. Literature review, data collection and processing, statistical analyses, and evaluations were conducted by Tuğçe Sarıoğlu. The writing of the article was done by Tuğçe Sarıoğlu, and the review and final corrections of the article were made by Prof. Dr. Haydar Şengül."

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