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IMMIGRATION, GROWTH AND UNEMPLOYMENT NEXUS: A LONG-RUN ANALYSIS FOR TÜRKIYE

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***Abstract**: This study employs VECM, FMOLS, DOLS, and CCR methods to comprehensively explore the diverse effects of total immigration, including regular, irregular, and refugee movements, on unemployment in Türkiye from 2000 to 2022. Model 1 analyzes the overall influence of immigration, revealing a quadratic relationship wherein immigration initially reduces unemployment before triggering subsequent growth. Notably, the study identifies a rise in GDP per capita following increased unemployment linked to immigration, attributed to a surge in refugees, especially post-2013. Refugees, with their informal employment contributions, are seen as positively influencing economic growth, but at the expense of higher unemployment rates. Conversely, Model 2 dissects the effects of regular and irregular immigration, coupled with economic, educational, and inflationary factors, on unemployment. The analysis discerns that irregular immigration heightens unemployment, while regular migration alleviates it. A significant proportion of regular immigration comprises short-term and student permits, contributing positively to economic development and mitigating unemployment. Irregular migration, akin to refugee influx, fosters economic growth through informal employment, adversely impacting formal unemployment rates. The model also reveals a negative association between education and unemployment, emphasizing that heightened education levels lead to skill development and reduced unemployment. Additionally, the study notes the simultaneous rise in unemployment and inflation, potentially linked to informal employment resulting from immigration.*

***Keywords:** Immigration; Unemployment; Production; Cointegration Regression Estimation*

1. Introduction

Although the adventure of immigration dates back to the beginning of human history, it started to be the subject of scientific research from the end of the 18th century and increased intensified after this date. it has become one of the main policy areas discussed

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in all of its dimensions, especially in the European Union and the United States, with the acceleration of globalization, especially after the 1980s.

Immigration, which often comes as a consequence of political, social, and economic upheaval in the country of origin, can also be the driving force behind change in the country that receives immigrants. When viewed in this light, immigration may be thought of as a process that has economic, social, political, and demographic repercussions on both the country of origin and the country of destination. During this process, it is possible that economic structures, demographic structures, social interactions, cultural values, and the labor market will be directly or indirectly influenced.

On the other hand, the resent immigration ideas are primarily motivated by economic considerations. The majority of immigration research in this setting focuses on labor immigration. This is because, historically, all immigrations resulting from factors such as climate, war, and natural disasters have been realized with the goal of satisfying fundamental economic necessities and gaining a high wage and level of life. Economics-based immigration theories based on supply and demand disparities in countries' labor markets are accepted as the first systematic theories to explain immigration flows. (Kritz et al., 1992). However, the influence of immigration on employment is a continuing and contentious issue that has seen an increase in empirical study.

From an economic point of view, immigration is discussed theoretically and empirically in terms of its effects on unemployment, wages, income and income distribution. Among these effects, it has become a subject of much debate because of the concerns that immigration may increase unemployment in the receiving country and cause a decrease in wages.

However, there is no clear consensus in the discussions on the effects of immigration on unemployment. While some empirical research supports the argument that immigration increases unemployment, some have not found a significant relationship between them. On the other hand, there are empirical research concluded that immigration reduces unemployment.

Most of the research employs partial equilibrium models that divide the workforce into skilled and unskilled categories at a given production technology level and argue that immigrants are perfect substitutes for indigenous skill categories. From this point of view, a rapid influx of unskilled immigrants changes the distribution of skilled-unskilled labor and increases unemployment in the unskilled category by creating an excess supply of low-skilled labor. Moreover, drives down wages for all low-skilled employees (Moreno-Galbis and Tritah, 2016). Even if immigrants and local employees are in the same competency group, if there is no full substitution between them, increased immigration may affect the wages of immigrants in the receiving country (Manacorda et al.,2012).

The partial equilibrium model examines the influence of immigration on unemployment using only labor market in which people are only inputs. Given the competitive market conditions, market forces efficiently adjust prices, and domestic labor wages fall as immigration causes a rise in supply in the labor market. However, the influence of immigration on labor income will be limited in the case that prices are sticky in a downward direction. (Espinosa & Díaz-Emparanza, 2021)

On the other hand, immigrants play multiple functions in the receiving economy in general equilibrium models. They boost the labor supply while also increasing the demand for materials produced in the receiving country. As a result, changes in per capita income generated by immigration in the receiving country contribute the income of the immigrant in return, having an unexpected influence on global economies (Dixit and Norman, 1980).

Hagen-Zanker (2008), the majority of contemporary immigration theories can be grouped together under the umbrella term of "neo-classical migration theory." This theory asserts that the fundamental drivers of immigration are variations in labor market supply and demand, as well as differences in the pay earned by workers in industrialized and developing countries.

According to traditional perspectives on immigration, if a country's immigrant labor population possesses the attributes that allow for the optimal combination of its production inputs, then the economy will experience increased productivity and growth. This means that the country grows more with immigration. However, immigration can result in a rise in the number of unemployed people and a reduction in the salaries offered by employers in the labor market if the labor force that is being imported is employed in jobs that

Borjas, (2003), the competitive labor market approach predicts that the increases in labor supply that are the result of immigration will shift the supply and push the equilibrium wage level down, and that the immigrants will partially replace the domestic labor force in the new equilibrium that will be created as a result of the shift. Borjas (2003) argues that the immigration of the native workforce from the sub-regions to other territory of Türkiye is a way to mitigate the negative effects of refugees.

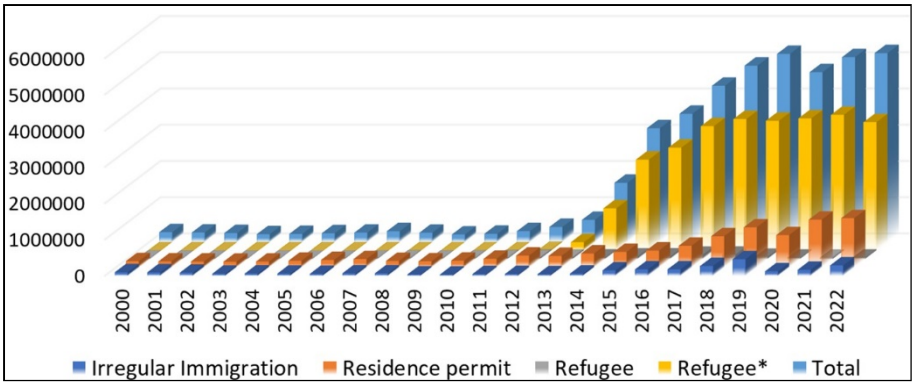
Due to the fact that they have a poor education level and qualifications that comprise of unskilled workers, refugees in Türkiye participate in employment as low-cost labor in industries that are both unsecure and informal (Ceritoglu et al., 2017). Because of this circumstance, there is a possibility of a substitution effect taking place in the labor market between the domestic labor force and the immigrant labor force.

Because of the dread that natives typically face when foreign labor enters the job market and competes with them, immigration has become one of the most debated immigration subjects. There are still disagreements over the impact of immigration on the unemployment of receiving countries, and even the most basic theoretical models cannot provide a clear answer.

Because of its vital geopolitical location and proximity to migratory routes, Türkiye is the country most affected by the world's expanding immigration movement. Consequently, the number of immigrants and refugees residing in Türkiye has increased dramatically during the past decade. The number of people forced to from their homes has considerably increased, primarily as a result of the political unrest in Syria, Iraq, and Afghanistan. The primary objective of this research is to find out if the increasing number of immigrants and refugees in Türkiye is having any effect on the country's high unemployment rate, which remains a problem despite the country's recent economic achievements.

The number of immigrants in Türkiye has grown by more than 2200 percent, from 223.900 in 2010 to 5.1 million in 2022. When the data from the Presidency of Migration Management of Türkiye is examined, the major cause of the growth in the number of foreigners in Türkiye during the previous ten years has been the influx of Syrian refugees. Furthermore, there has been a 720 percent increase in the number of residency permit holders.

Figure 1: Number of Immigrants to Türkiye (2000–2022)

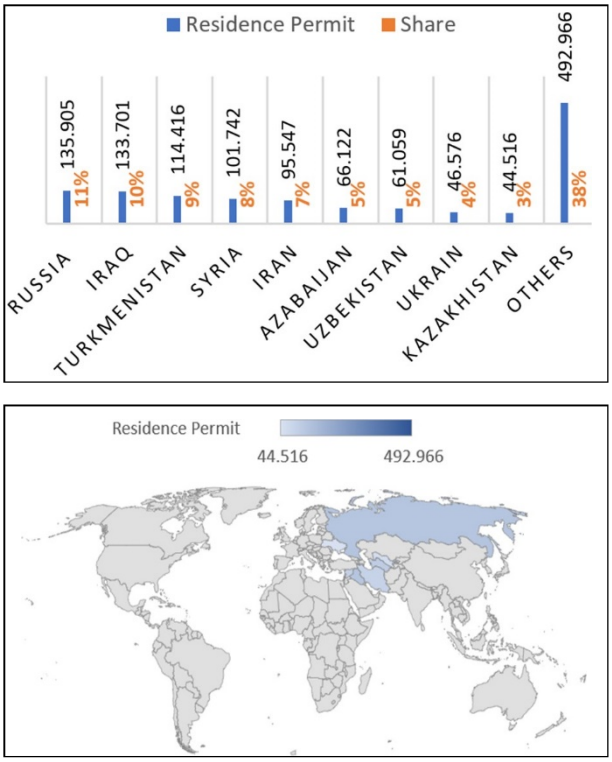


*Source: Author's analysis; *Syrian refugees*

Figure 1 presents a comprehensive overview of immigration trends in Türkiye between 2000 and 2022. It classifies the intake of immigrants into four categories: irregular immigration, residency permits, refugees, and the overall total. Significantly, there was a surge in irregular immigration in 2000, although it typically declined in the following years. The data on residence permits showed a consistent upward trajectory, suggesting a rise in the number of persons seeking legal authorization to remain. The refugee category saw a tremendous expansion, especially starting from 2013. It is clear that the majority of this rise is the result of Syrian immigration. The cumulative immigration statistics show a consistent rising trend, culminating at 5,208,255 in 2022, highlighting Türkiye's position in immigration.

Based on the data provided by the Republic of Türkiye Ministry of Interior Presidency of Migration Management, the analysis of residence permit numbers reveals that 60% of these licenses are classified as short-term permits, 12% are categorized as student permits, 10% fall under family permits, and the other 18% are classified as other permits. Figure 1 shows the residence permit of top ten countries Moreover in 2022. it is clear that the vast majority of foreigners who acquire residency permits are from nations such as Russia, Iraq, Iran, Syria and Ukraine, all of which are plagued by war and economic difficulties.

Figure 2: Residence Permit in 2022 of Top Ten Countries



Source: Author's analysis by using the dataset of R.TR. *Ministry of Interior Presidency of Migration Management*

The map in Figure 2 that shows the countries from which people immigrated to Türkiye also illustrates the effect that geography has on immigration due to Türkiye's strategic location and the fact that it is in a transition zone.

2. Literature Review

Scholars investigating the economic effects of immigration have typically concentrated their emphasis on three primary concerns. These are the drivers of the volume and structure of immigrant fluxes, the economic consequences of immigration and the assimilation of immigrants in receiving countries.

Because of the dread that natives typically face when foreign labor enters the job market and competes with them, immigration has become one of the most debated immigration subjects. There are still disagreements over the relationship between immigration and the level of unemployment in the nations that are receiving immigrants, and even the most basic theoretical models cannot provide a clear answer.

Chletsos and Roupakias (2012) employed cointegration and Granger Causality tests to investigate whether or not immigration, GDP, and unemployment were causally related in Greece over the course of the period 1980-2011. According to the findings of the analyses, immigration does not result in a decrease in unemployment and does not promote to economic growth in the short run.

The outcomes of the studies indicate that immigration does not result in a reduction in unemployment and does not promote to economic growth in the short-term.

According to Damette and Fromentin (2013), except for Anglo-Saxon countries in the short term, there is little indication of negative impacts on unemployment caused by immigration. The findings also show that unemployment and wages play a role in determining immigration levels, especially in Anglo-Saxon countries.

Applying the panel Granger causality testing method to annual data for 22 OECD countries between 1980 and 2005, Boubtane et al. (2013) examine the causal connection between immigration, unemployment, and economic growth in the receiving countries. Except for Portugal, none of the nations studied had a causal relationship between immigration and unemployment.

Using the OLS approach, Chamunorwa and Mlambo (2014) made an effort to investigate the influence that immigrant labor had on the unemployment rate in South Africa over the course of the period 1980-2010. The study indicated that immigration levels and unemployment rates in South Africa are positively related to one another.

Latif (2015) carried out study utilizing FMOLS, DOLS, and VECM in order to investigate the influence that immigration had on the unemployment rate in Canada between the years 1980 and 2013. The findings of the research showed that immigration had a significant, positive, and unidirectional influence on unemployment over the short term. However, research has shown that immigration does not have a substantial effect on the level of unemployment over the long run.

According to Balkan and Tümen (2016), who used a method called "difference-indifferences" to investigate the connection between immigration from Syria to Türkiye and price changes, migration has an impact on the informal labor market. According to the findings of the study, immigrants take the position of native workers on the informal labor market, which results in a fall of 2.5 percentage points in the overall levels of consumer prices.

Ceritoglu et al. (2017) showed that the influx of refugees from Syria decreased the informal employment-population ratio by approximately 2.3% in Türkiye. According to the findings, the detrimental effects of the surge of refugees are experienced most keenly by indigenous women and the less educated members of the informal indigenous sector.

The research conducted by Breunig et al. (2017) between the years 2003 and 2012 revealed no evidence to suggest that immigration had an impact on the employment of native-born workers in Australia.

Škuflić and Vučković (2018) investigated the effect of immigration on unemployment in 9 European Union member countries for the period 2004-2015. In this study, in which

Fixed Effects Panel Data Analysis was performed, it was concluded that increases in the level of immigration reduce unemployment. Accordingly, immigration affects unemployment negatively.

Using the Granger Causality technique, Nurdoğan and Şahin (2019) investigated whether or not immigration had an impact on unemployment in Türkiye between 1995 and 2019. The results point to immigration as a long-term contributor to the unemployment.

Between 1990 and 2016, Özcan (2020) analyzes the relationships between immigration, wages, and income in 15 US states using a Panel Granger causality technique. The results demonstrate that in seven states immigration increases unemployment whereas in the other eight states it has no effect on unemployment.

Using the VECM technique, EbuAlsoud, Alqudah, and Elish (2020) examined the dynamic short-and long-run relationship between immigration, unemployment, labor income, and GDP per capita in Australia over the period 1980 to 2016. They were unable to determine whether the economic effects of immigration on the labor market were positive or negative. The report offers policymakers compelling proof of the favorable spillover impact of the Australian government's immigration programs

Esposito et al., (2020) use a Panel ECM to determine the short- and long-term effects of immigration on unemployment for 15 EU nations between 1997 and 2016. In the long run, immigration only decreases unemployment in nations on the periphery, although in the short run, unemployment falls in all tested countries.

Using panel regression analysis, Gündoğmuş and Bayır (2021) looked at the impact of international immigration on unemployment in 27 European nations between 2000 and 2017, and they found no statistically significant relationship between the variables.

Sertaş and Uluöz, (2021) used ARDL, DOLS, FM-OLS, and CCR methodologies to assess the impact of Syrian immigrants on unemployment in Türkiye from 2011:11 to 2020:02. The results revealed that Syrian refugee immigration has a considerable negative influence on the level of unemployment in the long run, implying that Syrian immigrants reduces unemployment in Türkiye.

Sengupta and Mihalache, (2021) The impacts of migration on unemployment were examined for 33 OECD countries from 1990 to 2017 using the Panel ECM, FMOLS, and DOLS methodologies. The outcomes indicate that immigration decreases unemployment in the short as well as the long run.

Faccioli and Vella (2021) concluded that immigration had a dominant job-creation effect using a structural VAR technique using monthly data from 2006 to 2019. That is, native unemployment reduces, causing overall unemployment to diminish, but foreign unemployment rises.

Tomohara, (2022) conducted research examining the effect that immigration had on the unemployment rate in Japan's manufacturing sector from 2009 to 2018. The study covered the years 2009 to 2018. As the number of immigrants increased in labor-scarce industries, the unemployment rate declined, according to the study of the data. This

method exposes sector-specific migration repercussions when applied to the examination of unemployment rates using industrial sector units.

Ajzenman et al., (2022) employed two-way fixed effects model with 2SLS model to determine whether immigrants have an effect on labor outcomes in Chile. The research reveals that, while immigration does not have a systematic effect on employment levels, it generates an increase in unemployment-related anxieties. The findings provide a logical explanation for anti-immigrant sentiment: a misunderstanding of immigration's effect on labor market conditions.

The empirical literature demonstrates that research on the interaction between immigration and native unemployment has been conducted for a number of countries and different timeframes, making use of a wide array of data and techniques. The most important takeaway from the study conducted on this subject is that it has not produced a consensus in either the short or the long term.

3. Empirical Analysis

In the empirical analysis, we delve into the intricate relationship between total, regular, and irregular immigration to Türkiye and the corresponding unemployment rates spanning the years 2000 to 2022. Following the presentation of our research model, it is fitting to provide details on pre-tests, parameter estimation techniques, and diagnostic tests to assess the validity of the model in our empirical investigation. In order to get reliable prediction findings in time series analysis, it is necessary for the series to exhibit stationarity. The stationarity of the variables was evaluated in this context using the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Zivot-Andrews (ZA) tests. Once the optimal lag-length was chosen, Johansen tests were performed to identify if there was a long-term link between the series, before proceeding to estimate cointegration regression. The estimation of long-term parameters was conducted using Vector Error Correction Model (VECM), Fully Modified OLS (FMOLS), Dynamic OLS (DOLS), and Canonical Cointegrating Regression (CCR) methodologies. The model's validity and diagnostic tests were assessed by a range of examinations, which included Breusch-Pagan/Cook-Weisberg, Cameron & Trivedi's IM, Breusch-Godfrey LM, Durbin's alternative, Jarque-Bera, Ramsey REST, and Variance Inflation Factor (VIF) tests.

3.1. Model Specification and Data Set

Table 1 presents a thorough summary of the essential variables and their corresponding proxies that are crucial to our investigation. The variables consist of Unemployment (UEM), which is assessed by the unemployment rate, Irregular Immigration (IIM), which represents irregular immigration trends, Regular Immigration (RIM), which is determined by statistics on residency permits, and Total Immigration (TIM), which is a combination of IIM, RIM, and Refugee numbers. Additionally, Inflation (INF) is captured through the consumer price index, while Education (SSE) is represented by secondary education data. The variable Income (GDP) is gauged using the GDP, PPP (current international $). Notably, the data sources encompass reputable entities such as the World Bank and

the Republic of Türkiye Ministry of Interior Presidency of Migration Management Statistics Database.

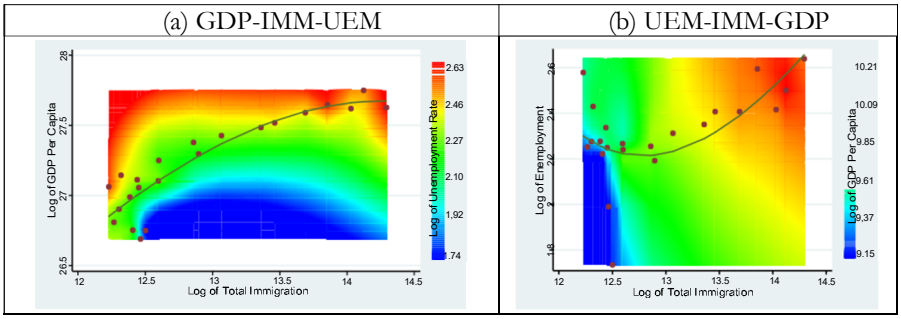
Table 1: Variables

Variable	Notation	Proxy	Source
Unemployment	UEM	Unemployment rate	World Bank
Irregular immigration	IIM	Irregular immigration	PMM of Türkiye(1)
Regular immigration	RIM	Residence permit	PMM of Türkiye(1)
Total immigration	TIM	IIM+RIM+ Refugee	PMM of Türkiye(1)
Inflation	INF	Consumer price index (2010 = 100)	World Bank
Education	SSE	Secondary education	World Bank
Income	GDP	GDP, PPP (current international $)	World Bank

Source: (1) Republic of Türkiye Ministry of Interior Presidency of Migration Management Statistics Database

Once we have a solid grasp of the important variables, we can begin visually analyzing the data to identify patterns and potential connections. The graphical representations below provide a dynamic perspective for observing trends, variations, and potential correlations among the variables. Through the use of the following plots, our goal is to provide a comprehensive analysis of the factors influencing the correlation between immigration and unemployment in Türkiye from 2000 to 2021. These visualizations not only improve our understanding of how variables change over time, but also lay the foundation for further quantitative analyses.

Figure 3: Visualizing the Multidimensional Relationship among Key Variables



Source: Author's analysis

Figure 3 illustrates potential relationships between unemployment, production, and immigration. In panel (a) of Figure 3, the relationship between immigration and GDP per capita is depicted using a scatter plot and fractional-polynomial prediction plot. The unemployment variable is added to the graph as a third dimension, represented by colors ranging from blue to red. Accordingly, in Figure 3 (a), as immigration increases, GDP per capita also increases, and this increase is accompanied by changes in the unemployment rate.

In Figure 3 (b) panel, the relationship between unemployment and immigration is illustrated similarly, employing a scatter plot and a fractional-polynomial prediction plot. In this case, the GDP per capita series is added to the graph as a third dimension through a colored contour plot. In Figure 3 (b), it is observed that an increase in immigration initially reduces unemployment up to a certain level. However, as immigration continues to rise, a turning point is reached, leading to an increasing trend beyond a certain minimum. The graph shows an increase in GDP per Capita in the region where it has a negative slope and beyond. While formulating the empirical model, we considered this quadratic relationship between immigration and unemployment.

In the model, unemployment is defined as the dependent variable, while immigration and economic growth are defined as independent variables. The functional formulation of the model can be seen in the equations as presented below (1) and (2).

Model 1: $UEM = f(TIM, TIM^2, GDP) \quad (Eq.1)$

$$lnUEM_t = a + \beta_1 \ln(TIM)_t + \beta_2(\ln(TIM))_t)^2 + \beta_3 \ln(GDP)_t + \varepsilon_t$$

In Modal 1, a represents the constant term, β_1 captures the linear impact of total immigration on unemployment, β_2 accounts for the quadratic impact of total immigration, reflecting the curvature in the relationship and β_3 represents the coefficient for the GDP variable, capturing its linear impact on unemployment. $(\ln(TIM)_t)^2$ represents the squared term of total immigration, introducing a nonlinear element. ε_t is the error term, representing unobserved factors influencing unemployment that are not explicitly included in the model. This expanded expression allows for the exploration of how both total immigration and GDP, along with their quadratic and linear components, collectively influence the dynamics of unemployment.

Model 2: $UEM = f(IIM, TIM, GDP, SSE, INF) \quad (Eq.2)$

$$lnUEM_t = a + \beta_1 lnIIM_t + \beta_2 lnRIM_t + \beta_3 lnGDP_t + \beta_4 lnSSE_t + \beta_5 lnINF_t + \varepsilon_t$$

In Model 2, a represents the intercept term, $\beta_1 \ldots \beta_5$ are the coefficients associated with the natural logarithm of GDP per Capita (GDP), irregular immigration (IIM), regular immigration (RIM), education (SSE), and inflation (INF), respectively. The error term is denoted by ε_t.

3.2. Estimators in Econometric Analysis

The Vector Error Correction Model (VECM) is a special case of the Vector Autoregressive (VAR) model that includes cointegration relationships among the variables. The general form of a VECM for a system with k variables is expressed as follows:

$$\Delta Y_t = \Pi_{t-1} + \Gamma_1.\Delta Y_{(t-1)} + \cdots + \Gamma_{(p-1)}.\Delta Y_{(t-p+1)} + \varepsilon_t \quad (Eq.3)$$

Y_t is a $k\ x\ 1$ of vectors at time t, ΔY_t is a $k\ x\ 1$ of vectors of first differences of Y_t, Π is a $k\ x\ k$ matrix of coefficients on lagged differences, ε_t is a $k\ x\ 1$ vector of white noise disturbances at time t, and p is the lag order of the model. The cointegration coefficients in Π represent the long-run relationships among the variables, and the lag matrices $\Gamma_1, \ldots, \Gamma_{p-1}$ capture the short-run dynamics. The error correction term in the model accounts for the adjustment process toward the long-run equilibrium when variables deviate from it.

The functional expression for The Fully Modified Ordinary Least Squares (FMOLS) can be represented as (Phillips and Hansen, 1990):

$$\Delta Y_t = a_0 + a_1.\Delta X_t + \sum_{i=1}^{p} \gamma_i.\Delta Y_{(t-i)} + \sum_{i=1}^{p} \delta_i.\hat{u}_{(t-i)} + v_t \qquad Eq.(4)$$

In Eq.(4), Δ denotes the first difference, p is the lag order, $a_0 and\ a_1$ are the FMOLS estimates of the intercept and slope, γ_i are the coefficients on the lagged differences of Y_t, δ_i are the coefficients on the estimated residuals from the first step, and v_t is the error term. The FMOLS estimator involves a two-step process. First step is to regress each variable on a set of lags of itself and other relevant variables. This is done to remove the endogeneity arising from the correlation between the variables and their errors. Denote the estimated residuals as $\hat{u}$ and the estimated parameters such as constant and slope. Regress the differenced dependent variable on the lagged differences of the dependent variable and the residuals obtained from the first step. The coefficients obtained from this regression provide the FMOLS estimates.

The Dynamic Ordinary Least Squares (DOLS) estimator is used to estimate parameters in models with integrated regressors. The functional expression for DOLS involves transforming the model in levels to a stationary form, similar to FMOLS. The DOLS estimator involves augmenting the model with lagged differences of the variables to remove the endogeneity problem. The general functional expression for DOLS can be represented as (Stock and Watson, 1993):

$$\Delta Y_t = a_0 + a_1.\Delta X_t + \sum_{i=1}^{p} \gamma_i.\Delta Y_{(t-i)} + \sum_{i=1}^{p} \delta_i.\Delta X_{(t-1)} + v_t \qquad Eq.(5)$$

The explanations of mathematical operators and symbols were provided in Eq.(4), so they are not reiterated here. Similarly, Canonical Cointegrating Regression (CCR) can be expressed as follows (Park & Phillips, 2001):

$$\Delta Y_t = a + \beta_1.\Delta X_{1t} + \beta_2.\Delta X_{2t} + \cdots + \beta_k.\Delta X_{kt} + \varepsilon_t \qquad Eq.(6)$$

In Eq.(6) $\Delta Y_t$is the differenced dependent variable at time $t. \beta_1, \beta_1, \ldots, \beta_k$are the cointegrating vectors associated with the differenced independent variables $\Delta X_{1t}, \Delta X_{2t}, \ldots, \Delta X_{kt}$. ε_t is the error terms.

3.3. Assessment of the Model and Parameter Estimation

Table 2 displays descriptive statistics that provides the complex relationship between socioeconomic factors and immigration patterns using a dataset consisting of 23 observations. Our study covers a variety of important factors, providing insights into the complex dynamics that influence modern societies. The unemployment rate is a crucial parameter that provides valuable insights into the fluctuations of the labor market. On average, it stands at 10.31%. In addition, the numbers for irregular immigration show significant fluctuations, with an average of around 101,942 people and a wide range from 16,996 to 454,662. Regular immigration, with an average of 400,200 individuals, plays a crucial role in demographic shifts. The overall immigration, which includes both irregular and regular streams, demonstrates an average influx of 1,656,248 individuals, underscoring the intricate nature of immigration patterns. The inflation rates, averaging at 122.18, highlight the economic dynamics, while the education levels, with an average of 8,608,566, and the income per capita, averaging at 19,039, offer a comprehensive socioeconomic context.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Unemployment rate	23	10.31	1.90	5.67	14.00
Irregular immigration	23	101942	98836	16996	454662
Regular immigration	23	400200	339436	152203	1354094
Total immigration	23	1656248	1987750	204467	5188479
Inflation	23	122.18	76.82	20.60	314.81
Education	23	8608566	2215320	5658333	11531571
Income per capita	23	19039	7251	9280	30472.38

Source: Author's calculations

Table 3 presents the results of unit root tests for various socioeconomic indicators, examining both their levels and first differences. The Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Zivot-Andrews (ZA) tests are employed to scrutinize the stationarity properties of the Unemployment Rate (UER), Total Immigration (TIM), Irregular Immigration (IIM), Regular Immigration (RIM), Inflation (INF), Education (SSE), and Income per Capita (GDP).

Table 3: Unitroot Tests

Variable	ADF-Test		PP-Test		ZA- Test	
	I(0) t-Stat	I(1) t-Stat	I(0) Z(t) Stat.	I(1) Z(t) Stat.	I(0) t-Stat	I(1) t-Stat
UER	-2.560	-4.244*	-1.644	-4.449*	-3.590	-4.488**
TIM	-0.127	-5.458**	-1.729	-6.062*	-2.130	-6.097*
IIM	-2.205	-4.249*	-2.336	-4.121*	-2.094	-8.042*
RIM	1.553	-4.627*	0.567	-6.681*	-0.625	-7.062*
INF	1.640	-2.999*	6.371	-5.487*	-0.926	-6.775*
SSE	-0.659	-4.631*	-1.870	-4.516*	-2.410	-5.366*
GDP	0.355	-3.063**	-1.596	-3.514**	-3.611	-4.881**

*Source: Author's calculations, * p<.01, ** p<.05*

The results from the ADF, PP, and ZA tests collectively indicate the presence of unit roots in the levels of all series examined. However, all three tests reject the null hypothesis of a unit root when the first differences are taken into account, thereby confirming the stationarity of the series.

Selecting an optimal lag length that balances model complexity and goodness of fit, crucial for robust and accurate time series analysis. In Table 4, we present the results of our optimal lag-length selection process, crucial for determining the appropriate time lags in our model.

Table 4: Optimal lag-length selection

lag	LL	LR	Prob.	FPE	AIC	HQIC	SBIC
0	-320.62			12904	17.9789	18.0249	18.1108
1	-193.514	254.21	0.000	18.2938	11.4174	**11.6017***	**11.9453***
2	-184.226	18.575	0.029	**18.2263***	11.4014	11.7239	12.3252
3	-178.836	10.781	0.291	22.9499	11.602	12.0626	12.9216
4	-165.69	**26.291***	0.002	19.3046	**11.3717***	11.9704	13.0871

Source: Author's calculations

In Table 4, different lag lengths (0 to 4) are evaluated based on various statistical criteria. The optimal lag length is determined by considering measures such as log-likelihood (LL), likelihood ratio test (LR), probability (Prob.), final prediction error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion (SBIC). The asterisks denote the selected lag length for each criterion. Given that both the HQIC and SBIC propose a lag length of 1, we shall use a lag length of 1 in our analysis.

Table 5 presents the results of Johansen tests for cointegration, which assess the presence of common stochastic trends among variables. The analysis is conducted for different hypothesized numbers of cointegrating equations (CE) and ranks, providing various statistics and critical values for evaluation.

Table 5: Johansen tests for cointegration

Ho: No. of CE(s)	Parms	LL	Eigenvalue	Trace Stat.	%5 Critical Value
$r = 0$	36	130.9165	.	190.184	82.49
$r \leq 1$	47	171.1841	0.98217	109.6487	59.46
$r \leq 2$	56	196.2662	0.91859	59.4845	39.89
$r \leq 3$	63	210.711	0.76413	30.5949	24.31
$r \leq 4$	68	220.9406	0.64047	10.1357*	12.53
$r \leq 5$	71	224.6267	0.3083	2.7636	3.84
$r \leq 6$	72	226.0085	0.12906		

Source: Author's calculations

In Table 5, we present the results of the Johansen tests for cointegration, a critical analysis for exploring the long-term relationships among variables. The null hypothesis (H0) posits the absence of cointegrating relationships, and the test assesses this hypothesis for different potential numbers of cointegrating equations (r). The parameters (Parms) represent the degrees of freedom in each test. The likelihood ratio test reveals compelling evidence against (r=0) cointegrating equations, as the trace statistic of 190.184 exceeds the 5% critical value of 82.49. This implies the existence of at least one cointegrating relationship in the system. Subsequent tests for (r≤4) continue to support the presence of cointegration, as the trace statistic remains above critical values. However, at (r≤5), the evidence weakens, and by (r≤6), there is insufficient support to reject the null hypothesis. This suggests that the system's cointegrating relationships are adequately captured with up to (r≤4) equations. That is, these outcomes support the presence of at least four cointegrating equations in the system.

Since the Johansen tests confirm the presence of long-term relationships among the series, we can now proceed to the estimation of long-term parameters. VECM, FMOLS, DOLS, and CCR cointegration regression methods were employed for the estimation of long-term parameters. The results of the empirical models shown in Eq.(1) and Eq.(2). using these methods are collectively reported in Table 6.

Table 6: Estimations

***ln*UEM**	**VECM**		**DOLS**		**FMOLS**		**CCR**	
_ce1	-.820** (.352)	-.711* (.273)						
*ln*ITM	-5.72* (.819)		-4.370* (1.118)		-3.985* (.407)		-4.038* (.520)	
(*ln*ITM)^2	.204* (.029)		.156* (.040)		.143* (.015)		.145* (.019)	
*ln*GDP	.595* (.060)	-.418* (.022)	.528* (.127)	-.454* (.136)	.409* (.050)	-.620* (.073)	.397* (.044)	-.535* (.0107)
*ln*IIM		.0431* (.008)		.060** (.026)		.066* (.011)		.059* (.0008)
*ln*RIM		-.035** (.016)		-.158* (.057)		-.233* (.033)		-.161* (.0051)
*ln*SSE		-.738* (.023)		-.068* (.191)		-.044 (.085)		-.274* (.0108)
*ln*INF		.776* (.022)		.657* (.077)		.814* (.057)		.787* (.0048)
R^2			.70	.90	.72	.83	.74	.97

*Source: Author's calculations. Note: ** p<.05, * p<.1*

In Model 1, the estimated coefficients for the log of total immigration (Log TIM), its squared term (Log TIM²), and the log of GDP per Capita (Log GDP) provide insights into the relationships with log unemployment. For Log TIM, the negative coefficients across all models (-5.72, -4.370, -3.985, -4.038) suggest that an increase in the log of total immigration is associated with a decrease in log unemployment. Similarly, in the case of Log TIM², the presence of positive coefficients (0.204, 0.156, 0.143, 0.145) suggests a quadratic correlation. This implies that the effect on unemployment first drops, but eventually starts to climb when overall immigration levels rise above a certain threshold. Additionally, Log GDP exhibits a positive relationship with log unemployment in all models, with statistically significant at 1% level. The goodness of fit is reflected in the R-squared values, with higher values (0.70 to 0.74) indicating a substantial proportion of the variance in log unemployment is explained by the models.

The coefficients in Model 2 for the variables Log GDP, Log IIM, Log RIM, Log SSE, and Log INF give insight into their unique associations with log unemployment. The log GDP per capita consistently exhibits negative coefficients (-0.418, -0.454, -0.620, -0.535) in all models, indicating a negative relationship with log unemployment at a significance level of 0.01. According to the VECM, DOLS, FMOLS, and CCR models, there is a consistent pattern where a 1% rise in log GDP per capita leads to a drop in log unemployment by 0.418%, 0.454%, 0.620%, and 0.535%, respectively.

The Log IIM has positive coefficients (0.0431, 0.060, 0.066, 0.059) demonstrate a positive connection between log irregular immigration and log unemployment. More precisely, a 1% rise in Log IIM leads to a proportional rise in log unemployment of 0.0431%, 0.060%, 0.066%, and 0.59%, respectively.

The coefficients (0.035, 0.158, 0.233, 0.161) of the Log RIM variable suggest a positive association between the logarithm of regular immigration and the logarithm of unemployment. Specifically, the VECM, DOLS, FMOLS, and CCR models indicate that a 1% increase in Log RIM results in corresponding increases in log unemployment of 0.035%, 0.158%, 0.233%, and 0.161%, respectively.

Log SSE has negative coefficients (-0.738, -0.068, 0.044, -0.274), indicating a negative association between the logarithm of education and the logarithm of unemployment. Specifically, a 1% rise in the log SSE is linked to a commensurate drop in the logarithm of unemployment by 0.418%, 0.454%, 0.620%, and 0.535%. The effect is statistically significant in the VECM, DOLS, and CCR approaches, but not in FMOLS.

Log INF) reveals a positive correlation between log inflation and log unemployment, as seen by the positive coefficients (0.776, 0.657, 0.814, 0.787). The results indicate that a 1% rise in log INF is linked to a corresponding increase in log unemployment of 0.78%, 0.66%, 0.81%, and 0.79%, respectively.

The R-squared values in Model 2, ranging from 0.83 to 0.97, reflect the goodness of fit, indicating the proportion of variance in log unemployment explained by the models. However, further testing is required for the validity of the models. For this purpose, tests related to "Model Validation" have been conducted under the following section.

3.4. Model Validation

In evaluating the validity of our model, we conducted a series of diagnostic tests, the results of which are presented in Table 7.

Table 7: Diagnostics for Model Validity

Test	Hypothesis	Statistics	Prob.
Breusch-Pagan/Cook-Weisberg	"H_0: constant variance"	$\chi2 = 2.42$	0.12
Cameron & Trivedi's IM Test	"Ho: homoscedasticity"	$\chi2 = 5.07$	0.41
Breusch-Godfrey LM test	"H_0: no serial correlation"	$\chi2 = 1.16$	0.28
Durbin's alternative test	"H_0: no serial correlation"	$\chi2 = 0.83$	0.36
Jarque-Bera test	"H_0: residual norm. distributed"	$\chi2 = 0.90$	0.64
Ramsey REST test	"H_0: model has no omitted variables"	F = 1.54	0.243
Mean VIF	"H_0: no multicollinearity"	3.65	-

Source: Author's calculations

"The Breusch-Pagan/Cook-Weisberg test", which examines the assumption of constant variance, resulted in a χ^2 statistic of 2.42 with a probability of 0.12. The findings indicate that there is insufficient evidence to reject the null hypothesis of constant variance at a significance level of 0.05. "The Cameron & Trivedi IM Test", which examines the assumption of homoscedasticity, yielded a χ^2 value of 5.07 with a probability of 0.41. The results indicate that the residuals of the model demonstrate homoscedasticity, since the null hypothesis is not rejected. When testing the hypothesis of no serial correlation, both the "Breusch-Godfrey LM test" and "Durbin's alternative test" yielded χ^2 statistics of 1.16 and 0.83, respectively. The associated probabilities for these values were 0.28 and 0.36. These data suggest that there is no substantial evidence rejecting the null hypothesis of no serial correlation. "The Jarque-Bera test", which is used to evaluate the normality of residuals, yielded a χ^2 value of 0.90 with a probability of 0.64. The results suggest that the residuals adhere to a normal distribution, as the null hypothesis is not rejected. Turning our attention to the "Ramsey REST test", which examines the presence of omitted variables, the F-statistic was calculated as 1.54 with a probability of 0.243. The test does not provide significant evidence against the hypothesis that the model incorporates all relevant variables. Lastly, "the Mean VIF", a measure of multicollinearity, yielded a value of 3.65. This result indicates that there are no substantial issues with multicollinearity, as the mean variance inflation factor remains below a predetermined threshold.

In conclusion, based on the outcomes of these diagnostic tests, our model appears to satisfy key assumptions, including constant variance, homoscedasticity, no serial correlation, normality of residuals, and adequacy in terms of variable inclusion and multicollinearity. These results bolster the confidence in the reliability and robustness of our model for the specified analysis.

4. Conclusion

A substantial amount of applied research has been performed to establish the link between immigration and employment in receiving countries. However, studies throughout time vary significantly, and no definitive conclusion has been reached to demonstrate a relationship between these characteristics. The purpose of this research is to determine, with the use of data from Türkiye, whether immigration has a major influence on the unemployment rate.

Given Türkiye's geographical location in the world, it becomes clearly evident that the country is susceptible to large-scale immigrant movements due to the political, economic, and social conditions that exist in the nations that surround it. It is plain to see that there has been a significant improvement in this mobility over the course of the previous ten years. It is of the utmost importance to do research into the economic effects of immigrant mobility, which are influenced by forces around the globe. One of these economic repercussions is the impact that immigration has on the rate of unemployment.

The analysis of immigration patterns in Türkiye reveals a significant surge in the influx of refugees, particularly starting from 2013. Additionally, it is observed that this significant surge in refugee influx has also stimulated the growth of informal employment. Therefore, two models have been used to examine the topic in this context.

The study analyzes the influence of total immigration, which includes both regular and irregular migration as well as refugees, on unemployment in Model 1. In Model 2, the study investigates the effects of regular and irregular migration on unemployment.

A quadratic model has been developed to represent the total immigration empirically. The analytical findings indicate that overall immigration first decreases unemployment and later leads to its growth. Curiously, it has been noted that a rise in unemployment linked to immigration is followed with a rise in GDP per capita. This phenomenon is attributed to a substantial increase in the influx of Syrian immigrants, particularly after 2013. Immigrants with refugee status are considered to have positively influenced economic growth by augmenting informal employment. Consequently, it is hypothesized that total immigrants have also contribute to the rise in unemployment rates inside the formal sector.

On the other hand, the impact of regular and irregular migration, along with other factors such as economic growth, education, and inflation, on unemployment has been examined in a separate model. Across all methods used in the analysis, including VECM, FMOLS, DOLS, and CCR, it is observed that irregular immigration increases unemployment, while regular immigration reduces it. Upon analyzing the constituent elements of regular immigration, it is seen that a substantial proportion (72%) comprises of short-term permits (60%) and student permits (12%). It is believed that regular immigration contributes positively to economic development by means of increased spending, hence mitigating unemployment. Irregular immigration increases unemployment, and this is accompanied by an increase in GDP per capita. Similar to refugee immigration, irregular migration, by increasing informal employment, contributes to economic growth, thereby negatively affecting unemployment in the formal economy. The model indicates a

negative relationship between education and unemployment, suggesting that an increase in education levels enhances skill levels, leading to a reduction in unemployment. Rising inflation is thought to be related to economic growth. However, the simultaneous increase in unemployment and inflation during the analyzed period is considered to be associated with informal employment due to immigration.

It is thought that it would be appropriate to evaluate the cost of the increase in the unemployment rate due to immigration, taking into account the positive effect of immigration on economic growth and its burden on the public. In future studies, it would be best to look at the economic effects of migration as a whole. This could be done by looking at both the negative effects on the public budget from higher transfer costs caused by immigration and the positive effects on economic growth.

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