

Determinants of Internal Migration in Türkiye: Evidence from a Spatial Panel SAR Model

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Abstract: Internal migration constitutes one of the most important mechanisms shaping regional demographic structures and economic dynamics. Understanding the factors that drive population mobility across regions is therefore crucial for both economic analysis and regional policy design. This study examines the determinants of interprovincial migration in Türkiye using annual provincial data covering the period 2008–2020. The analysis employs a spatial panel data framework and estimates a Spatial Autoregressive (SAR) model to capture both direct regional effects and spatial spillovers among provinces. The empirical results indicate that regional economic growth and human capital significantly influence migration patterns. Provinces with higher levels of economic activity and a greater concentration of university graduates tend to attract more migrants, highlighting the importance of economic opportunities and skilled labor environments in shaping mobility decisions. Public investment also exhibits a positive but relatively modest impact on migration flows. In contrast, technological development does not appear to exert a statistically significant influence on migration dynamics. Furthermore, the positive and significant spatial autoregressive parameter reveals the presence of spatial interdependence in migration flows across provinces. Overall, the findings emphasize that internal migration in Türkiye is closely linked to regional economic disparities and spatial interactions among provinces.

Keywords: Internal Migration, Technology, Human Capital, Public Investments, Spatial Panel Data

Jel Codes: J61, R23, C33, O15

Türkiye’de İç Göçün Belirleyicilerinin Ekonometrik Analizi: Mekânsal Panel SAR Modeli Bulguları

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Öz İç göç, bölgelerin demografik yapısını ve ekonomik dinamiklerini şekillendiren en önemli mekanizmalardan biridir. Bu nedenle bölgeler arası nüfus hareketliliğini belirleyen faktörlerin anlaşılması hem ekonomik analizler hem de bölgesel politika tasarımları açısından büyük önem taşımaktadır. Bu çalışma, Türkiye’de iller arası iç göçün belirleyicilerini 2008–2020 dönemine ait yıllık il verilerini kullanarak incelemektedir. Analizde, bölgeler arası etkileşimleri dikkate alabilmek amacıyla mekânsal panel veri yaklaşımı benimsenmiş ve Mekânsal Otoresgresif (SAR) model tahmin edilmiştir. Elde edilen bulgular, ekonomik büyüme ve beşeri sermayenin iç göç üzerinde anlamlı ve pozitif etkiler yarattığını göstermektedir. Ekonomik faaliyet düzeyi yüksek ve üniversite mezunu nüfusun yoğunlaştığı iller, göç açısından daha güçlü çekim merkezleri haline gelmektedir. Kamu yatırımlarının göç üzerindeki etkisi ise pozitif olmakla birlikte görece sınırlı düzeydedir. Buna karşılık teknolojik gelişmişlik göstergelerinin göç akımları üzerinde istatistiksel olarak anlamlı bir etkisi tespit edilememiştir. Ayrıca mekânsal otoresgresif katsayısının pozitif ve anlamlı olması, iller arasındaki göç hareketlerinin mekânsal bağımlılık içerdiğini ortaya koymaktadır. Genel olarak bulgular, Türkiye’de iç göçün bölgesel ekonomik farklılıklar ve mekânsal etkileşimlerle yakından ilişkili olduğunu göstermektedir.

Anahtar Kelimeler: İç Göç, Teknoloji, Beşeri Sermaye, Kamu Yatırımları, Mekansal Panel Veri

Jel Kodları: J61, R23, C33, O15

1. Introduction

Migration is a phenomenon as old as human history and constitutes one of the most fundamental dynamics shaping the demographic, social, and economic transformations of societies. As a multidimensional concept, migration has been studied across various disciplines, including sociology, history, geography, political science, and economics. While sociologists have examined the challenges faced by migrants during the process of integration into host societies, geographers have analyzed the spatial orientation of migration flows, and political scientists have focused on the legal and institutional frameworks that govern migration. Economists, on the other hand, have emphasized the impact of migration on human capital and its role in processes of economic growth and development (Sinha & Atallah, 1987; Brettell & Hollifield, 2015).

Theoretical approaches to migration have evolved over time. One of the earliest systematic frameworks, the neoclassical economic perspective, posits that wage differentials between developed and less-developed regions are the primary determinants of migration (Lewis, 1954; Todaro, 1969; Harris & Todaro, 1970). Piore's dual labor market theory later highlighted the structural demand for migrant labor in industrialized economies (Piore, 1986). Subsequent scholarship has argued that migration cannot be explained solely by economic factors; the pursuit of higher living standards, social mobility, and opportunities for future generations also play a significant role in shaping migration decisions (Castles & Miller, 2008).

With globalization, migration has become increasingly intertwined with political, cultural, social, and economic processes. Alongside the free movement of capital and goods, the permanent relocation of labor has rendered the economic implications of migration more visible. In this context, migration transforms the economic dynamics of both sending and receiving regions through various channels such as labor market adjustments, consumption patterns, infrastructure demands, and the provision of public services (Borjas, 1994; Boucher & Gest, 2015). Internal migration, in particular, refers to the movement of people within national borders in pursuit of better living conditions and economic opportunities. While internal migration contributes to increased labor supply and consumer demand in receiving regions, it can simultaneously lead to human capital losses in sending regions. Therefore, the economic impact of migration depends on the characteristics of migrants, especially their level of human capital and demographic profile (Lucas, 1988; Borjas, 1999; Göv & Dürrü, 2017).

The role of human capital in economic growth has been particularly emphasized within the framework of endogenous growth models (Barro & Sala-i-Martin, 1992). Internal migration redistributes human capital across space, thereby influencing economic growth through both direct and indirect channels. The concentration of skilled labor in receiving regions can enhance productivity and efficiency, whereas human capital depletion in sending regions may slow down development. Consequently, the relationship between internal migration and regional economic growth is frequently addressed in the literature as a determinant of regional inequalities (Krugman, 1991). Assessing the economic effects of migration in a comprehensive manner is therefore critical for designing policies aimed at reducing regional disparities. Maximizing the opportunities created by internal migration, while mitigating its potential drawbacks, constitutes a key factor in achieving sustainable growth and development.

Against this backdrop, the present study empirically investigates the main determinants of internal migration in Türkiye. The analysis is conducted at the provincial level in order to capture regional heterogeneity. The primary objective of the study is to identify the factors driving internal migration across provinces systematically. In this regard, economic variables are incorporated into the model, and their effects on migration decisions are empirically tested. The methodological approach employed aims to make an original contribution to the literature by relying on an extensive dataset while providing a detailed analysis at the regional level. The main objective of this study is to identify the determinants of internal migration in Türkiye using provincial-level panel

data while explicitly accounting for spatial interactions across regions. Although previous studies have examined migration dynamics in Türkiye, most rely on aggregated regional data or earlier periods and largely overlook spatial interdependencies between provinces. However, migration is inherently spatial, as economic and social developments in one province may influence migration decisions in neighboring areas. To address this limitation, the study employs a fixed-effects panel data framework combined with spatial econometric techniques using a comprehensive provincial dataset covering recent years. This approach allows the analysis to control for unobserved time-invariant provincial characteristics while also capturing spatial spillover effects in migration flows. By incorporating spatial dependence into the empirical framework, the study provides a more robust and detailed assessment of the economic determinants of internal migration.

The remainder of the study is structured as follows. The second section discusses the migration–economy nexus; the third section reviews the literature; the fourth section presents the data, model, and methodology; the fifth section reports the empirical findings; and the final section concludes with policy implications.

2. Migration and the Economy

2.1. Economic Drivers of Migration

Migration is a multidimensional phenomenon that has been extensively examined across the social sciences. Due to its complexity, the concept has been defined in various ways, yet in its most general sense it refers to the temporary or permanent movement of individuals or groups from one settlement to another. When this mobility occurs within national boundaries, it is defined as internal migration, whereas in the international context it is referred to as external migration (Tekeli & Erder, 1978). Migration not only reshapes the spatial distribution of population but also produces significant economic, social, cultural, and political consequences (Lee, 1966). In general, the principal motivation behind migration decisions can be explained as individuals' aspiration to attain higher levels of welfare and improved living conditions (Gençler, 2002).

Theoretical perspectives on migration have evolved and diversified over time. The first systematic contributions were made by Ravenstein (1885, 1889), whose pioneering studies became known as the "laws of migration." Ravenstein emphasized that individuals predominantly migrate over short distances, with flows mainly directed toward industrial and commercial centers, and underscored the decisive role of economic factors. He further observed that the regions vacated by migrants were often reoccupied by new groups, and argued that migration waves could, over time, stimulate counter-flows. Within this framework, Ravenstein identified migration as cyclical in nature: while largely concentrated in short distances, it could also extend to long-distance movements under the pull of economic opportunities. Moreover, he found that women exhibited a greater propensity to migrate than men (Ravenstein, 1885).

Building on these foundations, Stouffer (1940) introduced the "intervening opportunities theory," asserting that, in addition to distance, the availability of economic and social opportunities plays a critical role in migration decisions. Migration was thus conceptualized not merely as spatial mobility, but as a process directly associated with individuals' perception of opportunities. These early approaches offered a fundamental framework for explaining the direction and character of migration, and they laid the groundwork for subsequent theoretical developments.

Economically oriented migration theories gained prominence particularly in the twentieth century. Lewis (1954) conceptualized migration as a transfer of labor from rural areas to industrial centers. Sjaastad (1962) interpreted migration as a rational decision-making process, in which individuals weigh the expected future earnings against the costs of moving. Harris and Todaro (1970) explained migration decisions as the outcome of income differentials between low-wage rural areas and the expected returns in urban

labor markets. Collectively, these models demonstrate that migration is rooted in labor market disequilibria, wage differentials, and disparities in regional development.

Over time, however, alternative perspectives emerged, stressing that migration is not determined solely by individual choices but is also shaped by structural and societal dynamics. Examples include Petersen's core-periphery model, migration systems theory, network approaches, dual labor market theory, and the new economics of labor migration. Furthermore, Guilomoto and Sandon's institutional approach highlighted that migration is influenced not only by economic factors but also by social and institutional arrangements. In this regard, migration theories aim to explain a multidimensional process shaped by the interaction of economic, social, and institutional dynamics, alongside individuals' pursuit of higher welfare and opportunities.

Today, migration remains a central subject of inquiry in the economics literature, particularly in relation to the redistribution of human capital, labor market imbalances, and regional development disparities. In his seminal work *Intervening Opportunities: A Theory Relating Mobility and Distance* published in 1940, Samuel Stouffer analyzed the sociological dimensions of migration, focusing particularly on the relationship between mobility and distance (Akyıldız, 2016: 135). He observed that while a significant share of migrants relocate over short distances, long-distance migration also occurs in pursuit of access to trade centers and broader employment opportunities. According to Stouffer, distance constitutes a key determinant of migration decisions, yet economic considerations also play an important role. Nevertheless, his analysis underscores that spatial factors exert greater influence than economic ones in shaping migration outcomes (Stouffer, 1940: 845).

Arthur Lewis, in his seminal 1954 work *Economic Development with Unlimited Supplies of Labour*, examined the economic dimensions of migration and analyzed the relationship between unlimited labor supply and development. Within the framework of classical economic assumptions, the model posits that in regions characterized by low wage levels, an unlimited labor supply may exist, leading to a transfer of labor towards areas offering higher wages. Initially designed for closed economies, the model was later adapted to open economies as well (Lewis, 1954: 139–140). Lewis's analysis underscores that migration essentially reflects a movement from low-wage regions toward areas offering greater economic opportunities (Akyıldız, 2016: 137).

Larry Sjaastad, in *The Costs and Returns of Human Migration* (1962), approached migration from a cost-benefit perspective. Anchored in the classical economic framework, his analysis assumes individuals to be rational decision-makers whose migration choices are shaped by a comparison between expected returns and associated costs. According to Sjaastad, when anticipated returns outweigh costs, the likelihood of migration increases, whereas in cases where costs dominate, migration is avoided (Sjaastad, 1962: 82–83). Within this framework, the benefits of migration are categorized as both pecuniary and non-pecuniary. While pecuniary benefits refer to increases in real income gained in the destination region, non-pecuniary benefits encompass factors such as favorable climatic conditions, improved social networks, or higher quality of life (Sjaastad, 1962: 85–87).

Everett Lee, in his influential 1966 study *A Theory of Migration*, conceptualized migration through the framework of push and pull factors. In his model, each region embodies both positive (pull) and negative (push) conditions that influence migration dynamics. Push factors represent conditions that compel individuals to leave their current place of residence, while pull factors denote the advantages that attract them to a new location. Migration decisions are thus determined by a combination of negative aspects of the region of origin, opportunities presented by the potential destination, barriers encountered in the process, and the individual characteristics of migrants (Lee, 1966: 50). Consequently, regions dominated by push factors become net migration senders, whereas those shaped by pull factors emerge as net receivers.

John Harris and Michael Todaro, in their 1970 article *Unemployment and Development: A Two-Sector Analysis*, developed a two-sector model to explain rural-urban migration

dynamics. In this framework, wage differentials, unemployment rates, and broader economic conditions are considered the primary determinants of migration decisions. Harris and Todaro demonstrated that migration from rural to urban areas continues even when marginal productivity in agriculture remains positive. This paradox is explained by the fact that individuals base their migration decisions on expected income differentials rather than actual wage levels. As long as the expected urban income exceeds that of rural areas, the rural-to-urban migration flow persists, even under conditions of urban unemployment (Harris & Todaro, 1970: 126).

Evert E. Petersen, in *A General Typology of Migration* (1958), proposed a classification of migration motives under five distinct categories, offering a general conceptual framework for analyzing migration dynamics:

Primitive Migration: Forced movements resulting from natural disasters and environmental pressures (Petersen, 1958: 27).

Forced and Impelled Migration: Movements caused by wars, political coercion, or social pressures, where individuals are either compelled or strongly encouraged to migrate (Petersen, 1958: 259).

Free Migration: Voluntary movements driven by economic, social, or environmental considerations without the presence of coercion (Petersen, 1958: 260).

Mass Migration: Collective movements facilitated by advances in transportation and technology, whereby individual migration flows evolve into large-scale population movements (Petersen, 1958: 261–263).

Another major theoretical contribution to the study of internal and international migration is the core–periphery approach, developed through the works of Immanuel Wallerstein, Samir Amin, Stephen Castles, Johan Galtung, Kosack, and Andre Gunder Frank. According to this perspective, the world economy is structured as a dual system of core and periphery countries. Within the framework of capitalist production relations, core countries maintain structural and economic dependency relationships with peripheral ones. As capitalism deepens these dependencies, core countries attract migrants from peripheral regions to satisfy their demand for cheap labor, reduce production costs, and accelerate capital accumulation. Over time, however, migration also facilitates the transfer of capital and knowledge to peripheral regions, thereby contributing to the global reproduction of the capitalist system (Çağlayan, 2006: 79).

Another influential perspective in the migration literature is Mabogunje's (1970) migration systems theory. This approach argues that migration should not be explained solely by individual or economic factors, but rather must be analyzed within the broader context of inter-country relations and historical processes. Migration systems refer to networks of flows that emerge between two or more countries. Such networks may develop between geographically proximate states or across long distances. The theory emphasizes that migration should be examined through the interaction of both macro-level dynamics (institutional, economic, and political structures) and micro-level processes (interactions among individuals with migration potential). Accordingly, migration systems theory provides a holistic explanation of migration, supported by historical and mathematical analyses (Mabogunje, 1970: 1–2).

Another widely discussed perspective is the network theory of migration. This approach highlights how social ties among migrants facilitate migration decisions by lowering both costs and risks, while also sustaining migration over time through the institutionalization of these networks. As migrant networks expand and strengthen, the effectiveness of migration policies may become limited, since such networks often render migration a self-perpetuating process. In some cases, restrictive or selective migration policies may even unintentionally reinforce existing social networks, thereby intensifying migration flows (Ak, 2021: 1754).

Michael Piore's (1979) dual labor market hypothesis also constitutes a cornerstone of migration theory. Piore argues that labor markets are segmented into a primary sector (characterized by high wages, stability, and social protection) and a secondary sector

(characterized by low wages, insecurity, and instability). Migrant labor is predominantly absorbed into the secondary sector, shaping the disadvantaged position of migrant groups within host labor markets. In this sense, migration is not merely the outcome of individual economic rationality but also a structural response to segmented labor demand (Piore, 1972: 1; Wickramasinge & Wimalaratana, 2016: 23).

A further contribution comes from Oded Stark's new economics of migration. Stark (1991) argues that migration decisions are not exclusively individual choices, but rather collective strategies shaped at the household level. From this perspective, migration functions as a strategy for diversifying household income, mitigating poverty risks, and improving relative welfare positions. Remittances sent by migrants directly reduce poverty levels among households in sending countries, while also facilitating the capitalist transformation of agricultural production. Thus, migration is not only motivated by individual earnings but also by household-level strategies of risk management and income diversification (Toksöz, 2006: 20; Ak, 2021: 1755).

Another important theoretical framework is the institutional approach developed by Guilmoto and Sandon (2001). This perspective contends that the institutionalization of migrant networks reduces migration costs and thereby encourages migration flows. As migrant networks evolve into institutionalized structures, migration ceases to be a purely individual decision and instead becomes embedded within broader social and structural processes (Akyıldız, 2016: 165). The theoretical foundation of this study draws on the neoclassical migration framework, Ravenstein's migration laws, and the new economics of migration, all of which highlight the central role of regional economic disparities in shaping migration decisions. These perspectives collectively suggest that individuals respond to differences in income levels, employment prospects, and broader economic opportunities across regions. Building on this conceptual foundation, the variables incorporated into the empirical model are designed to operationalize these underlying mechanisms. In particular, regional income (GDP) is treated as a key economic pull factor reflecting spatial differences in economic prosperity and labor market opportunities across provinces. Human capital and patent indicators are included to capture the knowledge base, innovative capacity, and the potential for high-productivity employment within regional economies. Public investment is incorporated as a proxy for institutional support and infrastructural development, both of which can enhance the economic attractiveness of a region by facilitating economic activity and fostering the emergence of regional growth poles. Within this framework, the empirical analysis seeks to evaluate whether internal migration in Türkiye is predominantly driven by economic pull factors associated with regional development and opportunity differentials.

2.2. The Economic Consequences of Migration

A substantial body of research has examined the economic dimensions of migration and its implications for regional development. In recent decades, globalization has profoundly reshaped migration dynamics, influencing both the scale and structure of population movements. Theoretical approaches to migration generally fall into two broad categories: micro-level perspectives, which emphasize individual decision-making, and macro-level frameworks, which focus on structural economic conditions. Together, these approaches demonstrate that migration cannot be explained by a single determinant but rather emerges from a multidimensional interaction of economic, social, and institutional factors. Empirical studies highlight that migration decisions are shaped by variables such as the economic and administrative characteristics of destination regions, spatial distance between sending and receiving areas, the duration of migrants' stay, the strength of social networks and kinship ties, and individual attributes including ethnicity, gender, and socioeconomic status (Ak, 2021: 1755–1756).

From an economic perspective, migration is both a cause and a consequence of regional economic disparities. Differences in income levels, employment opportunities, and economic development across regions are widely recognized as key drivers of

population mobility. At the same time, migration generates a range of economic outcomes that vary between sending and receiving regions. In receiving regions, the inflow of migrants typically expands the labor supply and may stimulate economic activity through increased demand for goods and services. However, the magnitude and direction of these effects depend on local labor market structures, institutional conditions, and the skill composition of migrants (Borjas, 1999; Borjas, 2001).

Labor market adjustments constitute one of the most important channels through which migration affects regional economies. An increase in labor supply may diversify employment opportunities and support production capacity, yet in the short run it can also place downward pressure on wages or increase unemployment in certain sectors (Borjas, 1999; Gao, 2015: 57). Employers may perceive migrant labor as a cost-reducing input, potentially influencing wage dynamics and employment prospects for native workers (Şahutoğlu, 2023: 185–186). Nevertheless, regions capable of attracting skilled migrants often benefit from improvements in labor quality and productivity, which can reinforce long-term economic growth (Konya & Kabaklarlı, 2023: 21).

Beyond labor markets, migration may influence broader economic dynamics, including consumption patterns and local economic activity. The growing demand generated by migrants can expand trade and stimulate production in both industrial and service sectors (Noi, 2010: 8). At the same time, the extent to which migration affects local prices or living costs depends largely on the responsiveness of regional supply conditions (Borjas, 2001: 181; Oytun, 2015: 10). Consequently, the economic outcomes of migration are often context-specific and shaped by structural characteristics of the receiving economy.

Human capital constitutes another critical dimension of migration dynamics. The educational profile of migrants determines whether migration strengthens or weakens the human capital base of regional economies. Inflows of highly educated individuals may enhance innovation capacity and support economic growth, whereas a concentration of low-skilled migrants may produce more limited productivity gains (Ciccone, 2002: 304). Over time, however, migrants' integration into education systems and labor markets can contribute to improvements in workforce quality and long-term growth potential.

Migration also exerts significant effects on sending regions, particularly through the reallocation of labor and human capital. Outmigration often involves younger and more educated individuals, which may reduce local productivity and slow regional economic development (Lucas, 1985; Massey, 1990: 112). In rural areas, the loss of working-age population can weaken labor-intensive activities such as agriculture and limit the sustainability of local economic structures (Gurgand et al., 2014). Demographic changes associated with migration may further alter production and consumption patterns, as aging populations tend to display lower levels of economic dynamism.

At the same time, migration can generate compensating mechanisms through remittance flows and new economic linkages. Remittances may support household consumption and investment in the short term, although their long-term development effects remain debated in the literature (Stark & Bloom, 1985; De Haas, 2010: 169). More broadly, migration may contribute to uneven regional development by concentrating economic opportunities in already developed areas while weakening production structures in peripheral regions (Williamson, 1965; Bayraktar & Özyılmaz, 2019: 102).

Taken together, the literature suggests that migration affects regional economies through multiple channels, including labor markets, human capital accumulation, consumption dynamics, and regional economic activity. While these outcomes vary across contexts, a consistent finding is that migration decisions are closely linked to economic opportunity differentials between regions (Harris & Todaro, 1970; Katz & Stark, 1986; Castles & Miller, 2008). In this regard, regional income levels, innovation capacity, human capital endowments, and public investment are frequently identified as key factors shaping migration patterns. Building on this perspective, the present study focuses

specifically on the economic determinants of internal migration, examining how regional economic conditions influence migration dynamics at the provincial level in Türkiye.

3. Literature Review

Internal migration has become an increasingly significant component of socioeconomic transformation in Türkiye. Changes in regional economic conditions, technological progress, educational attainment, and public investment patterns are frequently identified as potential drivers shaping migration dynamics. As economic structures evolve, individuals tend to relocate in search of improved employment opportunities, higher incomes, and better living standards. At the same time, technological change and expanding educational attainment influence the spatial distribution of labor and the direction of migration flows. Public investments, particularly those aimed at regional development and infrastructure, may also alter migration incentives by improving economic opportunities in specific locations. Taken together, these factors highlight the importance of examining the determinants of internal migration within a comprehensive analytical framework that accounts for regional economic conditions and structural transformations in Türkiye.

Economic growth is widely recognized as one of the primary determinants of internal migration. Rogers (1967) examined interregional migration dynamics in California and demonstrated that economic opportunities—particularly employment prospects and associated income levels—play a decisive role in shaping migration flows. Similarly, Topbaş and Tanrıöver (2009) analyzed internal migration in Türkiye using population census data within the framework of the Lowry hypothesis. Their findings suggest that provinces with per capita gross domestic product (GDP) above the national average tend to attract migrants, while provinces with below-average GDP experience out-migration. Interestingly, the study also indicates that individual income expectations may influence migration decisions more strongly than aggregate economic growth indicators. In a provincial case study, Çiftçi (2019) investigated the relationship between economic growth and internal migration in Bilecik, Türkiye, using Pearson correlation and linear regression techniques. The results reveal a significant relationship between economic growth and net internal migration, with industrial production emerging as a key driver of migration dynamics. Overall, these studies suggest that economic development and regional income disparities constitute important determinants of internal migration.

Technological progress represents another factor that may influence migration dynamics. Recent research increasingly highlights the role of technological change in shaping labor demand and spatial mobility. Ghodsi, Landesmann, and Barišić (2024) examined the relationship between technology and migration across the European Union and several advanced economies—including Australia, the United Kingdom, Japan, and the United States—during the period 2001–2019. Using a gravity model grounded in neoclassical migration theory, the study shows that technological transformations, particularly digitalization and robotization, significantly influence migration flows by altering labor market structures. Similarly, Bekhtiar (2025) analyzed the impact of technological change on internal migration and rural decline in Austria between 2003 and 2016. The findings indicate that automation-driven reductions in manufacturing employment increased migration from rural areas toward regions offering better employment opportunities. Complementing these findings, Godin, Ozkul, and Humphris (2025) emphasize that technological advancements also influence migration through improved access to information. Enhanced digital connectivity enables individuals to better identify economic opportunities across regions, facilitating mobility and integration. However, unequal access to digital technologies may simultaneously generate new inequalities, limiting migration opportunities for disadvantaged groups. Overall, the literature suggests that technology affects migration dynamics through complex and multidimensional mechanisms.

Human capital constitutes another key determinant of internal migration. Educational attainment, in particular, plays a crucial role in shaping individuals' mobility decisions and the spatial distribution of skilled labor. Kodrzycki (2001) examined the migration patterns of university graduates in the United States and found that individuals with higher education degrees are significantly more likely to relocate to different states shortly after graduation. Migration destinations are often characterized by stronger labor markets, lower unemployment rates, and higher income prospects. Similarly, González-Leonardo et al. (2022) analyzed the relationship between education and internal migration across twelve European countries and reported that university graduates exhibit higher mobility rates than less-educated individuals. The study also indicates that highly educated foreign-born individuals are approximately twice as likely to participate in internal migration compared to their native-born counterparts. In the context of Türkiye, Aydemir et al. (2022) examined the relationship between education and migration decisions and found that educational attainment significantly increases the likelihood of migration among men, particularly during early adulthood. For women, however, employment opportunities appear to play a more decisive role than education alone. Evidence from developing regions also supports the importance of human capital. Ginsburg (2016) shows that individuals with higher education levels in African countries are more likely to engage in internal migration, as education facilitates access to economic and social opportunities. Taken together, these findings indicate that human capital plays a significant role in shaping migration decisions by influencing employment prospects and income potential.

Compared with other determinants, the relationship between public investments and internal migration has received relatively limited attention in the literature. One notable study in the Turkish context is conducted by Dayar and Sandalcı (2016), who examined the impact of public investments on migration dynamics in the TR33 Region (Manisa, Kütahya, Afyonkarahisar, and Uşak). Their findings suggest that although public investment may support regional development, its direct impact on migration patterns appears to be relatively limited. In particular, increased public investments in the region did not significantly improve employment opportunities and therefore failed to prevent out-migration. This evidence indicates that public investments alone may not be sufficient to alter migration dynamics unless they are accompanied by broader structural improvements in regional economic conditions.

Recent studies also emphasize the importance of spatial interactions in understanding migration dynamics. Çınar (2025) analyzed the spatial effects of internal migration in Türkiye using a Spatial Durbin Model (SDM) within a spatial panel data framework. The results indicate that while the direct effect of internal migration is statistically insignificant, both indirect (spillover) and total effects are positive and significant. This finding suggests that migration processes may generate spatial externalities across regions. In a related study, Çınar (2025) examined the relationship between internal migration and economic growth across Turkish provinces at the NUTS-3 level for the period 2008–2020 using spatial panel data models within an extended Solow–Swan framework. The results reveal significant spatial dependence in migration patterns and demonstrate that the growth effects of internal migration vary systematically across regions. Although the direct impact of migration on economic growth is negative and statistically insignificant, its indirect and total effects are positive and statistically significant. These findings highlight that migration-growth interactions primarily operate through spatial spillover mechanisms, suggesting that regional economic dynamics cannot be analyzed in isolation. Çınar (2026), internal migration across Turkish provinces during the 2008–2020 period exerts a negative direct impact on economic growth. However, migration also generates positive spillover effects in neighboring regions, and these opposing influences offset one another, leading to an overall statistically insignificant net effect.

Overall, the literature suggests that internal migration is influenced by a combination of economic, technological, and human capital factors, alongside regional policy interventions and spatial interactions. Examining these determinants collectively allows for a deeper understanding of the complex mechanisms driving migration dynamics. Building on this body of work, the present study investigates the determinants of internal migration in Türkiye using up-to-date provincial-level data within a panel data framework. By conducting analyses at the provincial level, the study accounts for regional heterogeneity and provides a more nuanced perspective on migration patterns. Accordingly, it is expected that the application of a methodologically rigorous model with current regional data will contribute meaningfully to the literature, offering new insights into the drivers of interprovincial migration and enhancing the understanding of regional migration dynamics in Türkiye.

4. Data, Model and Methods

This study covers the period from 2008 to 2020 and utilizes a balanced panel dataset comprising **81 provinces of Türkiye at the NUTS-3 level**. Thus, the analysis is conducted with a panel structure that includes both a time dimension (2008–2020) and a cross-sectional dimension consisting of **81 provincial units**. Explanations of the variables used in the analysis are presented in **Table 1**.

Table 1. Explanations of Variables Used in the Analysis

Variables	Abbreviation	Description
Net Migration	goc	Net Migration Per Population
GDP	lngdp	Provincial Gross Domestic Product
Technology	Intech	Number of Registered Patents by Province
Human Capital	lnhc	Number of Postgraduate Graduates by Province
Pyhsical Capital	lninv	Provincial Public Investment

Note: The abbreviations stand for the following: goc, lngdp from TURKSTAT: Turkish Statistical Institute, Intech from TPE: Turkish Patent Institute, lnhc from YOK: Council of Higher Education, and lninv from SBB: Presidency of Strategy and Budget

The empirical model of the study is specified as follows:

$$goc_{it} = \alpha + \beta_1 lngdp_{it} + \beta_2 Intech_{it} + \beta_3 lnhc_{it} + \beta_4 lninv_{it} + \epsilon_{it}$$

Panel data analyses are conducted using methods that account for both the temporal and cross-sectional dimensions. In the first stage of this study, the basic panel data model is estimated using the classical Ordinary Least Squares (OLS) approach:

$$Y_{it} = \alpha + \beta X_{it} + \epsilon_{it}, \quad i=1, \dots, N; t=1, \dots, T$$

Here, Y_{it} denotes the dependent variable, X_{it} represents the explanatory variables, α is the intercept term, and ϵ_{it} denotes the error component. In panel datasets, if there exist unobserved individual-specific heterogeneities, classical OLS estimators may become biased and inconsistent (Hsiao, 2014).

The fixed effects (FE) estimator controls for unobserved unit-specific heterogeneity by incorporating an individual effect (μ_i), which is allowed to be correlated with the explanatory variables.

$$Y_{it} = \alpha + \beta X_{it} + \mu_i + \epsilon_{it}$$

Here, μ_i captures unobserved and time-invariant individual effects. The FE model ensures consistent estimation of the regression coefficients by controlling for these fixed effects (Wooldridge, 2010).

By contrast, the random effects (RE) approach treats unit-specific effects as random variables and assumes that they are uncorrelated with the explanatory variables:

$$Y_{it} = \alpha + \beta X_{it} + u_i + \epsilon_{it}$$

In this framework, u_i denotes the unit-specific random effect, while ϵ_{it} represents the idiosyncratic error term. The random effects (RE) estimator yields efficient estimates under the assumptions that the variance of the unit-specific effects and the variance of the idiosyncratic error term are constant and given by:

$$\text{Var}(u_i) = \sigma_u^2 \quad \text{Var}(\epsilon_{it}) = \sigma_\epsilon^2$$

Under these assumptions, the RE model treats the unobserved individual effects as random variables that are uncorrelated with the explanatory variables (Baltagi, 2021).

The choice between fixed and random effects models is determined by the Hausman test (Hausman, 1978). The test statistic is formulated as follows:

$$H = (\beta^{RE} - \beta^{FE})' [Var(\beta^{FE}) - Var(\beta^{RE})]^{-1} (\beta^{RE} - \beta^{FE})$$

A statistically significant result indicates that the difference between β^{RE} and β^{FE} is systematic rather than random, implying correlation with the explanatory variables; in this case, the fixed effects model is preferred. Conversely, if the result is not significant, the random effects model is deemed more efficient.

Another methodological issue concerns the treatment of time effects. The baseline specification retains province fixed effects but does not include a full set of time dummies. This choice reflects the main objective of the study, namely to identify how province-specific differences in regional economic conditions are associated with migration patterns. Given the relatively short time dimension of the panel (2008–2020), the inclusion of a complete set of year effects would absorb a substantial part of the common temporal variation in the regressors and weaken the identification of the regional effects of interest. Nevertheless, common macro shocks affecting all provinces—such as the global crisis, regional migration shocks, and the pandemic—may still influence the estimates, and this issue should therefore be regarded as a limitation of the baseline specification.

A further caveat relates to potential endogeneity. In particular, economic growth and human capital may be jointly determined with migration. Provinces that attract migrants may subsequently experience changes in output, labor-market scale, and the local stock of skilled labor, while selective migration can also alter the human capital composition of both sending and receiving provinces. For this reason, the estimated coefficients should be interpreted primarily as conditional associations rather than strict causal effects. Possible simultaneity may bias the estimated magnitudes upward or downward, and future research may address this issue through instrumental-variable strategies, dynamic panel estimators, or spatial dynamic specifications.

5. Empirical Findings

This study estimates the determinants of internal migration across Turkish provinces. To this end, panel data analyses were conducted for the period 2008–2020 using the Ordinary Least Squares (OLS), Fixed Effects (FE), and Random Effects (RE) methods. The dependent variable is internal migration, while the explanatory variables include provincial gross domestic product, the number of registered patents, the number of university and college graduates, and public investment at the provincial level. Descriptive statistics of the variables are presented in Table 2. The explanatory variables were transformed into their natural logarithmic (ln) form prior to estimation. By contrast, the dependent variable (goc) was retained in level form because it contains negative

values in several province-year observations, which makes a standard logarithmic transformation infeasible. Accordingly, the logarithmic specification was applied only to the strictly positive regressors (lngdp, Intech, lnhc, and lninv). This transformation was used to improve comparability across explanatory variables, mitigate scale differences, and allow the coefficients on the logged regressors to be interpreted as semi-elasticities with respect to internal migration.

Table 2. Descriptive Statistics

Variables	Mean	Std. Deviation
Net Migration	-2.260969	14.516090
GDP	22.17156	1.095816
Technology	0.0514292	2.217865
Human Capital	10.61729	1.110048
Physical Capital	5.014089	1.848902

Note: The analysis is based on 1,053 observations. Descriptive statistics for *goc* are reported in level form, whereas the explanatory variables are reported in logarithmic form.

The dependent variable in the analysis is per capita internal migration, while the explanatory variables comprise provincial GDP, the number of registered patents, human capital (proxied by the number of university and college graduates), and public investment. The analysis is based on 1,053 observations. Using the OLS, FE, and RE estimators, the determinants of internal migration in Türkiye were examined. The estimation results are reported in Table 3.

Table 3. Hausman Test Results

Hausman	Value	Prob.
	45.15	0.00***

Note: *** shows significance at the 1% level, ** at the 5% level, and * at the 10% level.

To determine whether the fixed or random effects specification is more appropriate, the Hausman test was conducted. The null hypothesis (H_0) was rejected, indicating that the RE model is not valid. Consequently, the FE model provides consistent and reliable estimates. Estimation results from the OLS, FE, and RE models are reported in Table 4.

Table 4. Results of Ordinary Least Squares, Fixed Effects and Random Effect Models

Variables	OLS	Fixed Effects	Random Effects
	Coef. Prob.	Coef. Prob.	Coef. Prob.
GDP	-0.01(0.00)***	0.006(0.03)**	0.008(0.00)***
Technology	0.001(0.00)***	-0.0003(0.30)	-0.0001(0.60)
Human Cap.	0.0003(0.75)	0.005(0.00)***	-0.004(0.00)***
Physical Cap.	0.0007(0.01)**	0.001(0.00)***	0.001(0.00)***

Note: *** shows significance at the 1% level, ** at the 5% level, and * at the 10% level.

As shown in Table 4, the results of OLS, FE, and RE estimations are presented. In line with the Hausman test results, the FE model was found to be the most appropriate specification. Therefore, the interpretation of the determinants of internal migration in Türkiye is based on the FE model estimates.

It should be noted that the primary limitation of the OLS (pooled) estimator in panel data analysis is its inability to account for unobserved, time-invariant heterogeneity across units. If such heterogeneity is correlated with the explanatory variables, OLS estimates become biased and inconsistent. In this context, the FE model produces more reliable results, as it controls for individual-specific fixed effects and allows for an unbiased estimation of the relationship between the dependent and explanatory variables (Allison, 1994, p. 27).

In the fixed effects (FE) approach, time-invariant factors are eliminated from the model. Consequently, even if variables such as gender, ethnicity, or geographical location are included, their effects are absorbed by the fixed effects (Guo & Hipp, 2004, p. 346). By contrast, the random effects (RE) model treats such unobserved heterogeneity as part of the error term, assuming that it is uncorrelated with the explanatory variables (Bollen, 2011, p. 19). If this assumption holds, the RE model provides more efficient estimates than the FE model, as it yields lower standard errors and offers greater statistical power (Vignoles et al., 2009, p. 15). Furthermore, RE models allow the effects of time-invariant variables to be estimated, which constitutes an important advantage, particularly in policy analysis (Bell & Jones, 2015, p. 134).

Regarding model selection, the most widely employed method in the literature is the Hausman test. When individual fixed effects are correlated with the explanatory variables, the RE model becomes inconsistent, and under such circumstances, the FE model is preferred (Hausman, 1978, p. 1251).

Based on the FE model, the findings of this study reveal the key determinants of interprovincial internal migration in Türkiye between 2008 and 2020. First, the positive and statistically significant effect of gross domestic product (GDP) on migration is consistent with the classical approaches in the migration literature. The seminal Harris–Todaro model (1970) argues that migration decisions are driven by expected income differentials between rural and urban areas. The results indicate that provinces with greater economic capacity become more attractive destinations for migrants, and as production levels increase, in-migration also rises. This suggests that migration in Türkiye continues to be shaped primarily by disparities in economic opportunities.

The strong and positive effect of human capital further demonstrates that migration is influenced not only by income differences but also by individuals' knowledge, skills, and educational attainment. Borjas' (1989) self-selection framework emphasizes that migrants' educational and occupational attributes shape both their migration decisions and their economic integration in destination regions. The fact that provinces with higher levels of human capital serve as migration hubs in Türkiye highlights the role of demand for skilled labor in driving migration flows, underscoring the close link between migration dynamics and labor market structures.

The positive impact of public investment on migration is also consistent with findings in the development economics literature. Investments in infrastructure, health, and education not only shape the spatial distribution of economic activities but also improve living standards, thereby directly influencing migration decisions. In Türkiye, public investments appear to operate as a migration-enhancing factor, illustrating how regional development policies have important implications for migration dynamics.

By contrast, the absence of a statistically significant effect of technology on migration is a noteworthy finding. While theories of new economic geography and innovation-driven growth (Romer, 1990; Krugman, 1991) argue that technology and innovation act as important drivers of regional attractiveness, the evidence for Türkiye over the period 2008–2020 suggests otherwise. This can be attributed to the concentration of technological investment in a limited number of metropolitan areas, the relatively small number of employment opportunities created in technology-based sectors, and the fact that the majority of migrants consist of low- and medium-skilled workers. Hence, the determinants of migration in Türkiye remain largely shaped by traditional economic factors—GDP, public investment, and human capital—whereas technology-driven dynamics do not yet play a significant role in shaping migration flows.

In addition to the Hausman test, standard panel diagnostic tests were performed for the baseline FE specification. Specifically, the Modified Wald test was used to examine groupwise heteroskedasticity, the Wooldridge test was employed to detect first-order autocorrelation, and the Pesaran CD test was applied to assess cross-sectional dependence. The results are reported in Table 5.

Table 5. Classical Panel Diagnostic Test Results

Tests	Statistic	p-value	Short Interpretation
Modified Wald	$\chi^2(81) = 4982.11$	<0.001	Groupwise heteroskedasticity is present
Wooldridge	$F(1,80) = 9.44$	0.003	First-order autocorrelation is present
Pesaran CD	CD = 19.96	<0.001	Cross-sectional dependence is present

As reported in Table 5, the null hypotheses of homoskedasticity, no first-order autocorrelation, and cross-sectional independence are rejected. Accordingly, the baseline FE specification is affected by heteroskedasticity, serial correlation, and cross-sectional dependence. These findings indicate that the baseline non-spatial panel model departs from the classical error assumptions and should therefore be interpreted with caution.

Importantly, these diagnostic tests are reported as complementary specification checks and do not, by themselves, determine the choice of a spatial model. In regional panel datasets, such departures from the classical assumptions are common because provinces may be exposed to shared macroeconomic shocks, nationwide policy changes, and interprovincial spillovers. For this reason, the presence of heteroskedasticity, autocorrelation, and cross-sectional dependence should not be interpreted as a contradiction of the spatial analysis; rather, it reinforces the need to move beyond a naive non-spatial panel specification. The decision to adopt the SAR model is based specifically on the spatial LM diagnostics reported below, which directly assess whether the residual dependence is more consistent with a spatial lag process or a spatial error process.

For the spatial analysis, W is defined as a row-standardized first-order queen contiguity spatial weights matrix, in which provinces sharing either a common boundary or a common vertex are treated as neighbors and assigned positive weights, whereas non-neighboring provinces receive zero weight. A queen contiguity structure is preferred in the provincial context because Turkish provinces have irregular geographical shapes and migration-related spillovers may reasonably pass not only through shared borders but also through corner-touching units. Compared with a rook criterion, the queen matrix provides a less sparse and more realistic representation of regional interaction patterns for migration, labor-market linkages, and spatial spillovers. The SAR specification is preferred because the spatial LM diagnostics provide stronger support for dependence operating through the spatially lagged dependent variable than through the error term. Accordingly, the SAR model is better suited to capture interprovincial spillover effects in migration flows.

In empirical analyses based on regional or provincial data, economic interactions across geographical units may generate spatial dependence. Ignoring such spatial interdependence can lead to biased and inefficient estimates, as traditional econometric models assume cross-sectional independence. Therefore, before estimating the econometric models, it is essential to examine whether spatial dependence exists in the data. In this study, the presence of spatial autocorrelation in the determinants of internal migration across Turkish provinces was first investigated using spatial diagnostic tests. In particular, the Lagrange Multiplier (LM) tests for spatial lag and spatial error dependence were employed to assess whether spatial effects are present in the model specification. These tests allow the identification of potential spatial spillovers arising either from the dependent variable or from the error term. The results of the LM diagnostics indicate whether conventional panel estimators are appropriate or whether spatial econometric models should be employed. If spatial dependence is detected, spatial

regression models provide a more suitable framework, as they explicitly account for spatial interactions between neighboring regions. Consequently, the findings of the spatial diagnostic tests serve as the basis for determining whether a spatial econometric specification should be adopted in the subsequent empirical analysis. The estimation results are reported in Table 6.

Table 6. Spatial Dependence Test Results

Tests	Value	Prob.
LMlag	9.14	0.00***
LMerr	10.27	0.06*

To determine the appropriate spatial econometric specification, Lagrange Multiplier (LM) diagnostic tests were conducted to examine the presence and nature of spatial dependence in the model. The LM-Lag test statistic is 9.14 with a probability value of 0.00, indicating statistically significant spatial lag dependence at conventional significance levels. By contrast, the LM-Error test yields a statistic of 10.27 with a probability value of 0.06, which provides only weaker and marginal support at the 10% level. Taken together, these findings indicate that spatial dependence is present in the data, but that the stronger evidence points to a spatial lag process rather than a spatial error process. Accordingly, the Spatial Autoregressive (SAR) model is considered the most appropriate specification for the empirical analysis. The SAR framework allows the model to capture spatial spillover effects by explicitly incorporating the influence of neighboring regions' migration dynamics on provincial internal migration outcomes in Türkiye. Therefore, the subsequent estimations are conducted using the SAR model in order to account for spatial interaction across provinces and to obtain consistent and reliable parameter estimates.

Table 7. SAR Model Results

	Direct Effects	Indirect Effects	Total Effects
Ingdp	1.353 (0.09)*	0.681 (0.11)	2.035 (0.09)*
Intech	-0.010 (0.89)	-0.004 (0.94)	-0.015 (0.89)
Inhc	0.872 (0.00)	0.439 (0.00)	1.312 (0.00)
Ininv	0.133 (0.08)	0.068 (0.11)	0.201 (0.08)
Spatial Hausman	37.45 (0.00)		
Spatial Rho	0.385 (0.00)		

The results of the Spatial Autoregressive (SAR) model indicate that regional economic growth exerts a statistically significant and positive effect on internal migration. Specifically, the direct effect of economic growth is estimated at 1.353 and is significant at the 10% level, suggesting that provinces with higher levels of economic performance tend to attract more migrants. In addition to this direct impact, the indirect (spillover) effect is positive (0.681), implying that economic growth in neighboring provinces also contributes to migration dynamics, although this effect is not statistically significant at conventional levels. When both components are combined, the total effect reaches 2.035 and remains statistically significant, indicating that economic growth plays a substantial role in shaping migration flows across provinces. These findings suggest that internal migration in Türkiye is strongly driven by spatially distributed economic opportunities, where both local and surrounding regional growth conditions influence individuals' relocation decisions.

The empirical findings reveal that technological development does not have a statistically significant effect on internal migration. The estimated direct effect (-0.010) is negative but extremely small and statistically insignificant, indicating that differences in technological capacity across provinces do not appear to influence migration decisions in a meaningful way. Similarly, the indirect effect (-0.004) and the resulting total effect (-0.015) are both negligible and statistically insignificant. This pattern suggests that

technological indicators, at least as measured in this study, do not constitute a primary pull or push factor in shaping interprovincial migration in Türkiye. One possible explanation is that technological capacity may influence economic performance indirectly through productivity and innovation, rather than directly affecting migration flows.

Human capital emerges as one of the most influential determinants of internal migration in the model. The direct effect of the number of university graduates is positive and highly significant (0.872, $p < 0.01$), indicating that provinces with a larger stock of educated individuals tend to attract more migrants. Moreover, the indirect effect (0.439, $p < 0.01$) is also statistically significant, demonstrating the presence of strong spatial spillovers. This result implies that the concentration of human capital in neighboring provinces contributes to increased migration flows as well. The total effect (1.312, $p < 0.01$) confirms the substantial role of educational attainment in shaping migration dynamics. These findings highlight the importance of knowledge-intensive environments and skilled labor concentrations, suggesting that migration patterns in Türkiye are closely linked to the spatial distribution of human capital.

Public investment also exhibits a positive association with internal migration, although the magnitude and statistical significance are relatively modest compared with other determinants. The direct effect is estimated at 0.133 and is significant at the 10% level, suggesting that provinces receiving higher levels of public investment tend to attract migrants. However, the indirect effect (0.068) is not statistically significant, indicating that investment in neighboring provinces does not generate meaningful spillover effects on migration flows. The total effect (0.201) remains positive and statistically significant at the 10% level, implying that public investment contributes to improving the economic attractiveness of provinces, albeit to a limited extent. This finding suggests that infrastructure development and government spending can play a supportive role in shaping regional migration patterns.

The spatial dependence parameter ($\rho = 0.385$, $p < 0.01$) is positive and statistically significant, indicating the presence of spatial interaction in migration flows across provinces. In other words, migration decisions in one province are influenced by migration patterns in neighboring provinces, reflecting the spatially interconnected nature of regional labor markets and economic opportunities. Furthermore, the Spatial Hausman test statistic (37.45, $p < 0.01$) strongly rejects the null hypothesis, confirming that the fixed-effects specification is more appropriate than the random-effects alternative. Overall, these diagnostic results support the validity of the SAR framework and underscore the importance of accounting for spatial spillovers when analyzing the determinants of internal migration in Türkiye.

6. Conclusion and Policy Implications

Migration has long been regarded as a key process influencing the demographic composition, social structures, and economic dynamics of countries. As a complex and multidimensional phenomenon, internal migration has attracted scholarly attention across numerous disciplines, including economics, sociology, geography, political science, and history. Within the economic literature, migration decisions are frequently explained by differences in economic opportunities across regions. Classical theoretical frameworks, particularly the model developed by John R. Harris and Michael Todaro, emphasize the role of expected income differentials as a fundamental driver of migration flows. Building on these theoretical insights, this study examined the determinants of interprovincial migration in Türkiye using provincial-level data for the period 2008–2020 within a spatial panel econometric framework. By incorporating spatial interactions and detailed regional information, the analysis contributes to a more comprehensive understanding of migration dynamics and offers new empirical evidence on the spatial determinants of internal migration.

The empirical findings reveal that regional economic performance plays a decisive role in shaping migration patterns. Provinces characterized by stronger economic growth

tend to attract a larger number of migrants, indicating that economic opportunities remain a fundamental pull factor in migration decisions. Moreover, although the spillover effect from neighboring provinces is not statistically strong, the positive sign suggests that economic expansion in surrounding regions may indirectly influence migration choices. These results highlight that migration flows are not determined solely by local economic conditions but are also embedded within a broader spatial economic environment. Consequently, regional economic disparities continue to act as a major force directing internal population movements across provinces.

In contrast, the analysis indicates that technological capacity does not exert a statistically meaningful influence on internal migration. The estimated coefficients suggest that differences in provincial technological indicators neither attract nor repel migrants in a significant way. This outcome may reflect the indirect nature of technology's role in regional development. Technological advancement may affect migration primarily through its impact on productivity, industrial development, and income generation rather than serving as a direct determinant of population mobility. Therefore, while technological progress remains an important component of long-term regional competitiveness, its influence on migration decisions may operate through broader economic channels rather than through immediate spatial mobility responses.

Human capital emerges as one of the most influential factors associated with migration flows. Provinces with a larger share of university graduates tend to experience higher levels of inward migration, suggesting that educated labor forces create attractive environments for economic activity and employment opportunities. Furthermore, the presence of significant spatial spillover effects indicates that human capital concentrations in neighboring provinces also contribute to migration dynamics. These findings underline the importance of knowledge-based regional ecosystems, where the accumulation of skilled labor not only strengthens local economic structures but also generates regional attraction effects that extend beyond provincial boundaries.

Public investment is also found to have a positive, though relatively modest, influence on migration patterns. Provinces that receive higher levels of government investment appear to attract additional migrants, indicating that infrastructure development and public spending may enhance the economic appeal of regions. However, the absence of significant spillover effects suggests that such investments primarily affect the provinces in which they are implemented rather than generating strong regional diffusion effects. This implies that the migration-related benefits of public investment are largely localized and depend on the direct improvements in economic conditions and public services within the receiving provinces.

The spatial econometric results further reveal the existence of significant spatial dependence in migration flows. The positive and statistically significant spatial autoregressive parameter indicates that migration patterns in one province are influenced by developments in neighboring provinces. This finding confirms that internal migration is not an isolated process occurring within administrative boundaries but rather a spatially interconnected phenomenon shaped by regional networks of economic activity and labor mobility. Additionally, the results of the Spatial Hausman test support the use of a fixed-effects specification, reinforcing the robustness of the empirical framework adopted in this study.

From a policy perspective, the findings suggest several important implications for regional development strategies. First, policies aimed at reducing regional economic disparities may help moderate uneven migration flows by creating more balanced economic opportunities across provinces. Strengthening economic growth in relatively less developed regions could reduce excessive migration pressures toward already developed urban centers. Second, expanding access to higher education and fostering human capital accumulation appear to be crucial for enhancing regional attractiveness and promoting sustainable economic development. Investments in education and skills development can generate long-term benefits not only for local labor markets but also for

broader regional economic networks. Third, although public investment has a positive effect on migration attraction, its localized impact indicates that such investments should be carefully targeted toward regions with high development potential or structural disadvantages. Strategic infrastructure projects and regional development programs may play a key role in improving the economic viability of lagging regions.

Overall, this study demonstrates that internal migration in Türkiye is shaped by a combination of economic growth, human capital distribution, and public investment, while also being influenced by spatial interactions among provinces. These findings emphasize the importance of incorporating spatial perspectives into migration research and regional policy design. Future research could extend this analysis by examining additional socioeconomic factors, alternative spatial modeling approaches, or micro-level migration data to provide a deeper understanding of the mechanisms underlying internal migration dynamics.

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