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ORIGINAL PAPER

Migrations in Spain: econometric models with demographic and economic variables (1950–2021)

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Abstract

This research addresses migrations with the analysis of the historical evolution of Spain in this subject, in the period 1950–2021, within the context of globalization and its determinants based on different theories. The main objective is to analyze the evolution of demographic dynamics and its relationship with economic indicators in Spain, having as a research question that there is a relationship between economic and demographic variables. Some of these variables are GDP per capita, unemployment rate, public health expenditure, aging index, dependency rate and foreigners. Particular emphasis has been placed on public health expenditure per capita and its spatial lag. The methodology was quantitative in nature. It was performed a multivariate analysis using econometric panel data models. With the latter, data broken down by Autonomous Communities or regions in Spain are used through panel data models that, by including more territorial data, make the results more robust and reliable. The results confirm the research questions made for the econometric models. For example, GDP per capita and public health expenditure have a direct and significant relationship with the number of foreign immigrants in Spain. However, aging index has an inverse relationship with foreigners, whereas no significant relationship has been found with unemployment rate.

Extended author information available on the last page of the article

Graphical Abstract

JEL Classification C23 · R110 · I00

1 Introduction: migrations in a context of world globalization

International migration is the most relevant demographic phenomena since the twentieth century and it increased a lot since the consolidation of the economic globalization, from 1973 onward, when the new capitalist restructuring derived from its crises (Muñoz Jumilla 2002). Since that date, the effect of globalization on migration, it has been of such magnitude that it is believed that there has not been a historical epoch, despite the mass migrations that preceded it, where migratory phenomena have acquired as much importance as they do today, both from a quantitative and qualitative point of view (Muñoz Jumilla 2002).

On the other hand, one cannot forget that international migration is the most complex demographic dynamic to analyze due to the difficulty of data record. Population movements have been happening in human species since prehistoric times. Any displacement is not necessarily a migration, although all migration implies displacement (Benlloch-Doménech and Barbé-Villarubia 2020). So, population movements are not a consequence due to the globalization. Globalization is a term that almost every professional uses in any discipline, and for which there is no clearly defined conceptualization. To a large extent, this is because there is no definition of globalization that encompasses all its perspectives (Muñoz Jumilla 2002). According to Arango (2007), globalization is the development of a unified world scenario or space. Taking into consideration its multidimensionality, Muñoz Jumilla (2002) highlighted three perspectives to be considered: sociocultural, politic and economic.

However, the world has become increasingly globalized from the colonization movements to uninhabited areas of the world until the rise of nations, from trade to global production, from distribution networks to the current explosion of international flows of services, capital and information. Some economic historians thought

that the era of globalization began in 1870. However, it has been relevant in its second stage with the end of the Second World War, economic autarky and nationalisms (Goldin and Reinert 2007).

In Europe, the great waves of migration were after World War II, when some European countries emitted the emigrant population. However, since 1950, other countries in Europe received immigration because they needed workers for post-war reconstruction. Raya Lozano (1999) counted around 20–30 million of displaced people (between refugees, nationals returning from former colonies, workers from Mediterranean Europe—mainly Italians and Spanish, workers from the Third World and populations from former colonies—such as France and Great Britain). In the case of Spain, the main emigrations since 1950 were toward former colonies such as the Philippines or Cuba, and toward Latin American countries (preferring Argentina, Brazil or Venezuela). In fact, Spain only became an immigration country with the economic expansion and the real state boom at the beginning of twenty-first century, since 2002 (Valero-Matas et al. 2014).

According to Castles et al. (2014), globalization is one of the patterns of international migration, as new flows are developing due to economic, political and cultural change, and violent conflicts. Despite the diversity, it is possible to affirm that the globalization of migrations tends to increase in more and more countries and gained a priority issue for national governments and international institutions (Benlloch-Doménech and Barbé-Villarubia 2020). According to International Organization for Migration (IOM), in 2018, more than 257 million of people were migrants, but outside of the global dimension, IOM points out that little is known about the phenomenon (Benlloch-Doménech and Barbé-Villarubia 2020). The recent data with the United Nations estimation was about 281 million international migrants in the world, that is, around 3.6% of the global population (United Nations 2022; IOM 2024). Looking back, in 2005 there were 191 million people according to the United Nations, while in 1970 they were 82 million, around 2% of the global population (Arango (2007); Valero-Matas et al. 2014). In 2024, nearly 300 million people around the world will need humanitarian assistance and protection due to conflicts, climate emergencies and other drivers (OCHA 2023). Internal displacement reached a record level at the end of 2022, with 71.1 million internally displaced persons (IDPs) around the globe (IDMC 2023). But where do these migrations take place? There is a general perception that most migrations come from South countries to North countries. It is true that almost half of the migrations are from South to North, as voluntary migrants from middle-income countries clearly move to high-income countries (Muñoz Jumilla 2002; Haba 2011). In fact, 65% of the world's migrants lived in developing countries (Woetzel et al. 2016) and the continents with largest number of international migrants are in the Global North: Europe with 87 million in 2020 and Northern America with 59 million in 2020 (UN 2020).

Focusing on Spain, since 1950, Spanish emigration primarily targeted former colonies like the Philippines and Cuba, as well as France, Switzerland and Germany in Europe, with economic factors becoming central after democracy began (Colectivo IOE 2003). In the twenty-first century, Spain transitioned into a major immigration destination, ranking second worldwide after the USA from 1990 to 2010 (Moraga 2019), with immigrants contributing 79% of the population growth from 2000 to

2020 (Moraga 2021). Latin American immigration surged during Spain's economic expansion (1998–2007), but the 2008 financial crisis led to significant return migrations, particularly among Latin Americans (Domínguez-Mujica et al. 2020). Strong correlations between immigration and emigration flows persisted until 2016, when the connection began to weaken as migration patterns became less linked to Spain's economic cycle. Prieto et al. (2015) also showed that returns were more significant than remigration, while McIlwaine (2015) and McIlwaine and Bunge (2016) studied more about Latin Americans remigrations from Spain.

International migration has become global. "Some scholars attribute this migratory globalization to the globalization of the economy" (Arango (2007), p. 5). However, Arango (2007) questions the current imbalance between potential emigrants and the immigration capacity of potential receiving countries. He concludes that, currently, there is an unaffordable imbalance for the countries receiving immigration, due to the demographic growth of Africa, Asia and Latin America. In such a way that the unlimited supply of workforce proposed by the classical economists, for which there is a minimum level of work performance, cannot be produced. Thus, confirming the limits of labor supply, when capital is scarce, using the "law of variable proportions" (Lewis 1960).

Due to scarcity of resources, according to Malthusianism and for other reasons, immigration has become one of the great concerns at a European level that must be addressed in a multidisciplinary way. Arango (1985) commented that the dimensions of migrations are multiple, because of these experts from different areas such as demographers, economists, sociologists, anthropologists, geographers, statisticians, social psychologists and historians are interested on this subject.

For this research, migration has been studied mainly in relation to economy and based on theories that some of them are commented in the posterior literature review section. Demography has their own dynamics independently, for example, according to the demographic transition theories (Van de Kaa 1987; Van de Kaa 2002) or the Easterlin's theory of demographic cycles in which he proposed that generations size changes cyclically (Sarrible 1998). But economy has their own dynamics too. Some of them were explained by different theories of business cycles. Burns and Mitchell (1946) were the promoters of this theory, although there was many authors who made contributions on it such as Juglar, Kalecki, Kondratieff or Kuznets. When both are studied with migrations, different factors, determinants and variables are analyzed in theoretical and empirical ways.

The main determinants of migration are economic reasons, distances (origin–destination), gender, place of residence (rural or urban), age, economic development, technological progress and transportation of the countries. Many of them belong to the well-known Ravenstein's laws (1885), to which can be added as determinants the social and family relationships that migrants have in a previous destination to which to migrate or the relationships that have been formed in the country to which they emigrated, as a possibility to root them. There are also some factors that favor the emigration of people (push) such as high demographic pressure, low wages or the lack of political freedoms and other factors that favor immigration (pull) such as the demand for labor, higher wages high, political freedoms and higher living standards.

Therefore, the objective of this article is to research the relationship between economic and demographic factors and migration flows within Spain, focusing on the potential bidirectional causal relationship between migration flows and public health expenditures. Also, other variables are analyzed such as GDP per capita, unemployment rate or aging index to understand their influence on migration patterns. Using econometric models applied to data at the regional level (NUTS-2), these questions were empirically examined.

The article is structured as follows: The next section reviews relevant literature on migration theories and its determinants or drivers, followed by a methodology section detailing the data, variables and models employed in the analysis. Then, the results are presented and the paper concludes with a discussion and final conclusions.

2 Literature review: theories and determinants of migrations

Some economic and demographic theories were reviewed. Along with economic theories related to migrations, the neoclassical economic theory of international migration can be highlighted because it explains how wages depend on the supply and demand for labor, that is, on the population and available capital.

There is an international consensus in recognizing Ravenstein as the first social scientist to analyze the phenomenon of migrations and establishing several laws between 1885 and 1889 (Benlloch-Doménech and Barbé-Villarubia 2020). Economic reasons are among the most important for migratory decisions (Ravenstein 1885). The population seeks opportunities, labor markets and economies to join in other places to develop a better life. But, according to Joaquín Arango (2007), it is not enough just for people to want to migrate, it is also necessary for them to be able to do so.

For the rest of Ravenstein's migration laws, other determinants of migrations can be identified, in addition to economic reasons (Simpson 2022). Ravenstein's laws are twelve statements defined as "a set of general empirical propositions, loosely related to each other, that describe migratory relationships between origins and destinations" (Zelinsky 1971 in Arango 1985).

Laws No. 2 and No. 3 refer to distances (origin–destination) as one of the main determinants, also identifying a gender difference in Law No. 8 (being women who carry out short-distance migrations and men those of longer distances). Law No. 7 refers to the place of residence as a determinant of migration; thus, people who live in rural areas are more likely to migrate than those who live in cities. Law No. 9 refers to age as a determinant, so migration happens more frequently in adults. And finally, Law No. 12 identifies other determinants of migration such as economic development, technological progress and transportation.

Later, in 1913, Fairchild (1913) classified human mobility into four types, but not all of them being explicitly called migrations. Invasion, conquest and colonization were differentiated, in addition to migration itself. This would be a concept attributable to the movements of the contemporary era, with a relatively long duration in time. Fairchild (1913) insisted, at the beginning of the twenty-first century that

the economic factor was the oldest and main factor to migrate. Nevertheless, the migratory phenomenon increased its complexity over time. Nowadays, besides labor migrants have a high prevalence because of push–pull factors, the named "migrants' lifestyle" do it for other reasons. This type of migration ("migration lifestyle") is very important, not only in the Spanish context (relevant on the Coast), but also in other contexts like Turkey, Australia and some areas of the USA (Benlloch-Doménech and Barbé-Villarubia 2020).

Economic, political and social determinants linked to the development on communication, internet or transports have been an advantage to dilute spaces and time in the context of globalization (Benlloch-Doménech and Barbé-Villarubia 2020). In fact, intensification of communication also favors the increase in migration lifestyle, since immigrants move with the idea that their families will visit them often (Benlloch 2016; Benlloch-Doménech and Barbé-Villarubia 2020).

Manuel Castells's theory (1997) about the network society, within modern sociology, explains how power is based on the control of information and communication (Castells 2006, 2012; Stalder 2006). With the creation of the Internet, companies are more interested in economic benefits through users and the data flow. However, States want security, control and power. The fact that society can be more communicated makes it easier for migrations, in the sense that it is easier to communicate with family, friends and even work or educational teams, if the interests and needs of each one require it. Likewise, the development in transport means that physical mobility can be faster and faster. Tourism is one type of mobility, and Valiente and Romero (2009) proved that there is a relationship between immigration and tourism, especially in some regions with a labor market where immigrants can be a workforce for some economic sectors.

The classic theory of push–pull factors explains the determinants of emigration (push factors) such as high demographic pressure, lack of access to land, low wages, low living standards, lack of political freedoms and repression. And also, some determinants of immigration (or pull factors) such as the availability of land, demand for labor, good wages, high standards of living or political freedoms. Another of the determinants of migration, that makes up the theory of social networks, is the new social and family relationships that the immigrant has formed in the destination country. This is probably the main determinant in their decision to return or not to their home country. De Miguel Luken (2020) did a social network analysis in migrant population, using the concepts of migratory network and about social capital. According to Alejandro Portes (2013), social capital is the access to human resources through links established between people or some resources that can be achieved by belonging to different organizations. This concept uses the egocentric network approach that used to be centered on the migrant person (De Miguel Luken 2020).

According to labor market theory, by Todaro (1969) and Borjas (1990), human migrations are considered as a mechanism for correcting the structural imbalances produced in the world labor market, i.e., the migratory flows are produced according to the supply and demand of the labor market of the different countries.

Oded Stark (1991) adds to labor market theory the influence of the family for migratory decisions, which is not an individual result. This is the theory of new

Table 1 Determinants of migrations and its theory supported. *Source*: Own elaboration, based on different authors

Theory	Determinants of migrations
Ravenstein laws	Economic reasons
	Distances and gender
	Place of residence (rural/urban)
	Age
	Economic development, technological progress and transportation
Push factors (out-migration)	High demographic pressure, lack of access to land, low wages, low living standards, lack of political freedoms or repression, among others
Pull factors (immigration)	Availability of land, demand for workforce, good wages, high living standards or political freedoms
Social network theory	The new social and family relationships that immigrants have formed in the country of destination
Labor market theory	Labor supply and demand in the labor market
New economics of migration theory	The influence of the family in migratory decisions
World interdependence theory	Voluntary organizations and private institutions

economics of migration by Oded Stark. Table 1 summarizes the determinants of migration commented in relation to its theories.

The rest of migration theories also contain other determinants. For example, the theory of migratory systems by Zlotnik (1992) would include the world interdependence theory, institutional theory, social network theory and the theory of cumulative causation.

For example, world interdependence theory positions voluntary organizations and organizations of private institutions as determining factors for migratory flows. However, the rest of the determinants are not seen since they are no longer as relevant.

Migrations are population movements but, according to Segal (2019), there are two factors that define their access to the host country: Migrations are voluntary or involuntary, and legal or illegal. It affects how migrants are perceived and their human and social capital (see any migration seeks to improve the quality of life, so economic factor is implicit as main determinant to out-migrate (Valero-Matas et al. 2014). Nowadays, the liberal thought from the mid-nineteenth and early twentieth centuries does not justify migratory relations with the principle of exchange, rationalism or individualism, but rather "migrations are considered authentic social phenomena that occur together with the internationalization of the capital" (Muñoz Jumilla 2002, p. 16) (Fig. 1).

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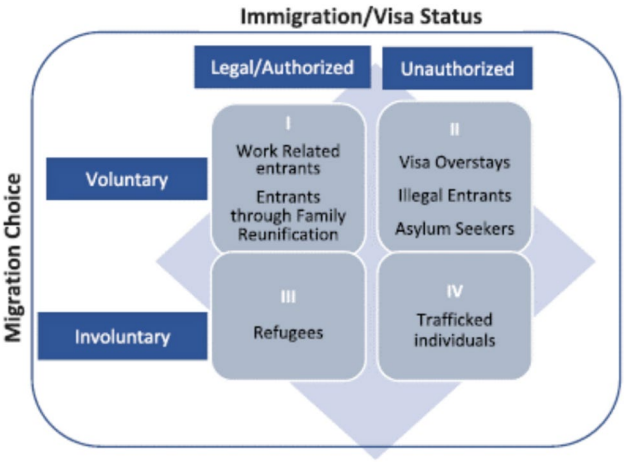

Fig. 1 Categories or types of immigration status. *Source*: Segal 2019, p. 137

Before to continue with the methodology and the analysis, it is relevant to reflect on one important question for this research. It is related to the relation between immigration (demographic dynamic) and labor market (economy), that is, if people follow jobs or if jobs follow people (Hoogstra et al. 2017; Østbye et al. 2018). Østbye et al. (2018) concerned bidirectional causality or circular causation for the relation immigrants-jobs, and the answer has important implications for policy guidance. "When people follow jobs, growth is induced by labor demand and policies should target jobs; when jobs follow people, growth is induced by labor supply and policies should target people" (Østbye et al. 2018). They did an empirical study of labor markets to regional/local level in Nordic countries, and they shared several characteristics. Hoogstra et al. (2005) concluded in their analysis that there is little overall support for bidirectionality and the question about it is unresolved after their empirical data analysis (Hoogstra et al. in Østbye et al. 2018). Mulligan et al. (1999) strongly supported the hypothesis that people follow jobs, according to the job market as pull factor (Classic Theory). However, Partridge and Rickman (2003) raised a question in urban and regional economics and the empirical results they found running SVAR models (*structural* VAR approach) were that labor-demand shocks are generally more important than migration labor-supply shocks, so job offer follows newly arrived migrants. Any direction about the question whether people follow jobs or if jobs follow people can be supported by the labor market theory (Todaro 1969; Borjas 1990), which considers that migrations and the job market can be balanced too.

Finally, the relationship between immigration and public health expenditures has been reviewed, a key economic factor with underlying demographic dimensions. Regarding the causality direction from immigration to health expenditures, increases in immigration can contribute to heightened health expenditures per capita in regions as the influx of new residents expands the demand for healthcare services, particularly in areas with established social welfare programs. New immigrants

often bring specific health needs, including those arising from prior limited access to healthcare or exposure to different disease environments, which can strain local healthcare systems and necessitate increased spending to maintain quality of care. Additionally, immigrants may utilize healthcare services at different rates due to factors such as language barriers, healthcare accessibility or varying levels of preventative care in their origin countries, leading to an upward adjustment in per capita health expenditure (Ku and Matani 2001). Given these dynamics, it is essential to investigate the bidirectional relationship between immigration and healthcare spending to understand whether increased health expenditures attract immigrants by improving living conditions or if immigration growth independently drives higher healthcare spending as regions adapt to demographic changes.

However, there are arguments to test the causal relationship from health expenditures to immigration. Increased health expenditures in specific regions can lead to higher immigration due to improvements in the availability and quality of healthcare services, which enhance overall living conditions and act as pull factors for migrants. Research indicates that immigrants are attracted to areas with robust social services, particularly in health and education, which serve as indicators of long-term stability and support systems for family and personal welfare. Enhanced healthcare infrastructure and access can also create positive externalities, such as reduced disease burden and improved public health, which are attractive to potential migrants evaluating destination regions (de Haas et al. 2019). Moreover, regions with significant investment in healthcare often signal economic vitality, which can drive both direct and indirect job creation, further attracting immigrants who seek economic and social stability (Burchardi et al. 2020). This correlation aligns with findings that suggest a connection between public service availability and immigration, where immigrants respond to signals of improved living standards and potential opportunities for integration (Venkataramani et al. 2020; de Haas et al. 2019).

3 Methodology

There are some studies that made a correlation between economy and demography with time series analysis, using econometric models. Some of them were founded for other demographic dynamics like mortality in Spain (Tapia Granados 2005) or fertility in the developed world (Sobotka et al. 2011).

This article addresses the issue of migration in the context of globalization and the determinants of migration based on theories. The research question is that some relevant economic indicators have impact on international migrations as one the demographic dynamics, which is innovative, in specific for Spain.

The study population for this research is the total resident population in the Spanish territory at each year throughout the timeline. Subsequently, it was decided to disaggregate the study population into Autonomous Communities, the regional administrative organization of Spain. Thus, each region could be studied and compared with the others to see inequalities or trends.

In terms of economics, the indicators have been chosen to carry out the economic and demographic analysis. Some selected economic variables are related to

Table 2 Economic and demographic variables selected. *Source*: author's own design

Economic variables	Socio-demographic variables
GDP per capita	Immigrants
Unemployment rate	Aging index
Health expenditure per capita	

consumption and production, since they are two basic functions carried out by the population: satisfying a series of needs for goods and services, and contributing to obtaining them (Tamames 1986).

Some economic and demographic variables gathered are GDP per capita, unemployment rate, public health per capita expenditure, immigrants (measured as foreigners) and the aging index (see Table 2). Regional-level (NUTS-2) per capita health expenditures were sourced from the Spanish Ministry of Health.[1]

This study draws on multiple secondary data sources, primarily from the World Bank, Spain's National Statistics Institute and the Spanish Ministry of Health. To facilitate meaningful comparisons and integration, all data was compiled on an annual basis. The territorial classification used follows the Nomenclature of Territorial Units for Statistics (NUTS), which standardizes European administrative divisions for statistical purposes.

A panel dataset for Spain's regions was constructed, known as "Autonomous Communities" (NUTS-2 level), covering the years 2003 to 2021, resulting in a total sample size of 306 observations. This regional approach, as opposed to national-level data, enables a more precise capture of the relationships among variables and provides a nuanced perspective on regional dynamics within Spain.

To investigate the interactions between international migration and economic and demographic factors, three econometric models were developed, summarized in Table 3, each with a clearly defined hypothesis. The results section provides a detailed assessment of each model, indicating whether the respective null hypotheses were accepted or rejected, and presenting empirical evidence on the significance of each variable correlation.

The relationship between immigration and health expenditures is analyzed bidirectionally, given theoretical support in the literature for both perspectives, as discussed in the previous section. These are the three models:

- Model 1: This model explores health expenditures per capita at the regional level, with immigration, GDP per capita, unemployment rates and the aging index as explanatory variables.
- Model 2: Inverts the relationship by explaining immigration levels through health expenditures per capita alongside the same controls.

[1] https://www.sanidad.gob.es/estadEstudios/home.htm.

Table 3 Regression model for hypothesis on the migrations subject. *Source*: author's own design

No	Model	Definition of hypothesis	Research hypothesis
Model 1	ΔHealth expenditures pc $= \beta 1 + \beta 2\ \Delta$ Immigrants $+ \beta 3\ \Delta$GDPpc $+ \beta 4\ \Delta$UnemploymentRate $+ \beta 5\ \Delta$AgingInd $+ \varepsilon$	An increase of health expenditures per capita will come from a previous increase in the immigrant figures, per capita GDP *per capita* and the aging index, and a decrease in the unemployment rate	$\beta 2 > 0$ $\beta 3 > 0$ $\beta 4 < 0$ $\beta 5 > 0$
Model 2	ΔImmigrants $= \beta 1$ $+ \beta 2\ \Delta$ Health expenditure pc $+ \beta 3\ \Delta$GDPpc $+ \beta 4\ \Delta$UnemploymentRate $+ \beta 5\ \Delta$AgingInd $+ \varepsilon$	An increase of foreign immigrants will come from a previous reduction in the unemployment, as well an increase in health expenditures per capita GDP *per capita* and the aging index	$\beta 2 > 0$ $\beta 3 > 0$ $\beta 4 < 0$ $\beta 5 > 0$

Table 3 (continued)

No	Model	Definition of hypothesis	Research hypothesis
Model 3	ΔImmigrants $= \beta 1$ $+ \beta 2\ \Delta$ Health expenditure pc $+ \beta 3\ \Delta W \cdot$ Health expenditure pc $+ \beta 4\ \Delta$GDPpc $+ \beta 5\ \Delta$UnemploymentRate $+ \beta 6\ \Delta$AgingInd $+ \varepsilon$	An increase of foreign immigrants will come from a previous reduction in the unemployment, as well an increase in health expenditures per capita (of the region and of their neighbor regions) GDP *per capita* and the aging index	$\beta 2 > 0$ $\beta 3 > 0$ $\beta 4 > 0$ $\beta 5 < 0$ $\beta 6 < 0$

- Model 3: Similar to Model 2, but with the addition of a spatial lag of health expenditures per capita.

The spatial lag of health expenditures per capita was created as follows:

1. An adjacency matrix W was constructed, where a_{ij} equals 1 if regions "I" and "j" share a border, and 0 otherwise (17 × 17 dimensions). The two insular regions are considered isolated, with no shared borders.
2. To calculate the spatial lag, it has been row-normalized W and multiplied it by the health expenditure variable, integrating this lagged term as an additional predictor in Model 3.

This methodological approach aims to account for spatial interdependencies while controlling for regional variations in health expenditures.

The general model to represent it for panel data is the following:

$$y_{it} = \propto + \beta x_{i(t-1)} + \beta x_{i(t-1)} + \cdots + U_{it}$$

y: dependent variable. β: model parameters. X: independent variables. t: year. Variations in X for the period $(t-1)$ affect Y for period t. U: error (collects everything that can influence the model and cannot be calculated).

A linear regression model requires that the variables are measured on a continuous scale (Cea D'Ancona 2004). A research hypothesis (H_0) must have been raised, which must be tested with the following hypothesis test: H_0: $\beta = 0$ and H_1: $\beta \neq 0$ (greater or smaller, depending on what the theory says), if the null hypothesis (H_0) is accepted or rejected.

The panel data is balanced and is part of a set of individuals (17 Autonomous Communities) observed in the period 2003–2021 (Carter Hill et al 2012).

There are different strategies to estimate panel data models when the alphas (α) vary. Considering that the betas (β) are common and constant for all individuals at all moments in time, there are two kinds of estimates: fixed effects models (F.E.) and random effects models (R.E.). Models can be estimated with the three approaches described in Carter Hill et al. (2012): random effects (R.E.), fixed effects (F.E.) or pooled effects (P.E.).

The Hausman test is used to check for any correlation between the error component and the regression in a random effects model (Carter Hill et al. 2012) and helps us counteract the estimation effects of panel data models. The Hausman test will allow us to choose which estimate is better in the proposed model.

The main advantage of this research methodology is that, over time, the databases can be expanded and improved (with historically longer series and data updates for each variable), as well as allowing international comparisons to be made. The same methodology and models can also be applied to other countries.

It is worth to remark that, to address non-stationarity in time series data, all variables are expressed as yearly differences. To avoid spurious regressions in econometric models (Yule 1926), Granger (1974) and Engle III (1982) got the Nobel Prize

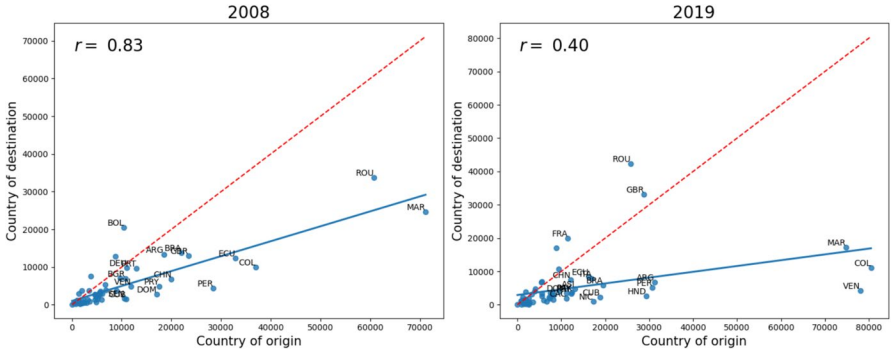

Fig. 2 Inflows and Outflows of Migrants by Country in 2008 and 2019 Plots includes different countries around the world: for Europe (EU-15, other EU countries and rest of Europe); for Africa (Algeria, Gambia, Ghana, Guinea, Equatorial Guinea, Mali, Morocco, Mauritania, Nigeria, Senegal and other countries); North-America (USA, Mexico and other countries like Canada); Centro America and Caribbean (Cuba, Honduras, Nicaragua, Dominican Republic and others); Latin American countries (Argentina, Bolivia, Brazil, Colombia, Chile, Ecuador, Paraguay, Peru, Uruguay, Venezuela and others); for Asia (Bangladesh, China, Philippines, India, Pakistan and others) and the countries for Oceania since 2015. *Source*: Authors' own design, based on Migration Statistics, SNI Spain

in 2003 for their contributions to be able to treat these correlations. These methods revolutionized the way econometrics works with time series data.

Furthermore, to mitigate potential circular or reversed causality issues, all explanatory variables are lagged by one period.

Each model was estimated using random effects, supported by the Hausman test results, which favored random over fixed effects ($p > 0.05$). Additionally, clustered robust standard errors by region were employed to ensure reliable inference.

4 Data analysis and results

Before delving into the econometric analysis of the interrelations among demographic and economic factors driving regional migration flows, it is insightful to first examine, at a national level, the inflows and outflows of migrants to and from Spain, as well as their evolution over time.

Dashed lines in Fig. 2 represent the $y = x$ line. Countries above this line indicate a negative migratory balance, meaning more people returned from Spain to their home country than migrated to Spain from that country. Conversely, countries below the line exhibit a positive net migration toward Spain.

Several notable patterns emerge from Fig. 2:

a) Changes in Major Migration Partners: The countries with the highest migration flows have shifted between 2008 and 2019. While Morocco remains a country with significant migration flows (both inbound and outbound), Romania, the second-largest contributor in 2008, no longer holds that position in 2019.

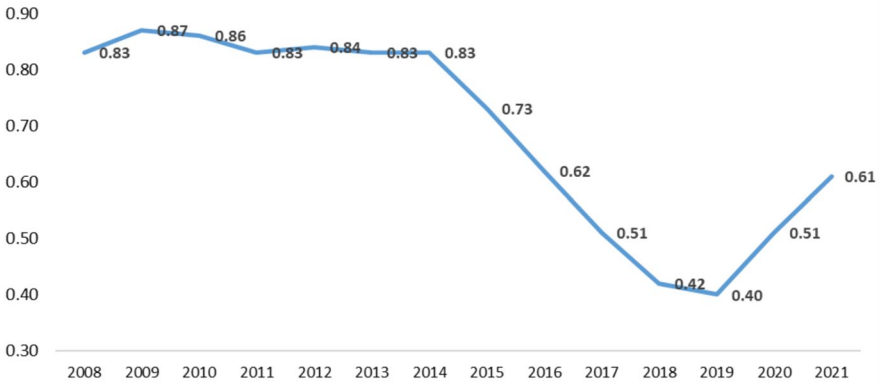

Fig. 3 Evolution of the Correlation Between Migration and Return Flows to and From Spain by Country (2008–2021). *Source*: Authors' own design, based on Migration Statistics, SNI Spain

Instead, Colombia and Venezuela have become prominent sources of immigration to Spain, likely driven by the political and economic crises in both countries.

b) Net Migration Trends: In both years, most points lie below the diagonal, confirming Spain's position as a net receiver of immigrants. Specifically, in 2008, Spain received 599,074 migrants and saw 288,432 people return to their home countries, while in 2019, these numbers increased to 750,480 arrivals and 296,248 returns.

c) Decoupling of Migration Flows: The correlation between incoming and outgoing flows by country has significantly weakened, dropping from 0.83 in 2008 to 0.40 in 2019. This suggests a growing disconnect between the two flows. Notable outliers in 2019 include Romania and the UK (GBR), where return flows exceeded arrivals. For the UK, this could be attributed to the effects of Brexit, while for Romania, the higher return rates may reflect the repatriation of retirees and early migrants as well as the economic downturn in Spain following the 2008 crisis, which heavily impacted sectors such as construction where Romanian workers were concentrated. The temporal evolution of these correlations is illustrated in Fig. 3.

The three models described have been estimated in the methodology section, and the results are presented in Table 4.

Based on the table of regression results, the findings of three econometric models examining the relationships between migration flows and health expenditures are presented, as well as other key economic and demographic variables at the regional level in Spain.

4.1 Model 1: determinants of health expenditures

Model 1 explores the impact of migration and economic factors on health expenditures per capita. The results show that the lagged change in immigrants (Δ Immigrants $(t-1)$) has a positive and statistically significant effect on health

Table 4 Results of regressions of the migrations models. *Source*: Authors' own design

	Y: D Health expenditures pc	Y: D Immigrants	
	Model 1	Model 2	Model 3
D Immigrants ($t-1$)	0.0005***		
	0.0001		
D Health expenditures pc ($t-1$)		69.029***	34.338***
		24.099	11.798
D W·Health expenditures pc ($t-1$)			117.030***
			33.176
D GDP per capita ($t-1$)	0.013**	4.996***	4.413***
	0.005	1.298	1.143
D Unemployment rate ($t-1$)	−8.049***	−115.303	−40.867
	1.594	510.640	505.951
D Aging index ($t-1$)	1.377	−4965.397**	−4909.687**
	2.024	2221.045	2166.062
Constant	38.328***	8871.481**	5458.944*
	3.867	3505.649	3040.270
N	306	306	306
R2 overall	0.1226	0.1793	0.2289
Wald statistic	91.28	19.57	28.61
p-value	<0.0001***	0.0006***	<0.0001***

Clustered robust standard errors below coefficient estimates

***, **, * indicate significance at 1.5 and 10%

expenditures per capita (coefficient = 0.0005, $p < 0.001$). Additionally, GDP per capita (Δ GDP per capita ($t-1$)) is positively associated with health expenditures (coefficient = 0.013, $p < 0.01$), while the unemployment rate (Δ unemployment rate ($t-1$)) has a negative effect (coefficient = −8.049, $p < 0.001$). These findings suggest that higher immigration levels and economic growth contribute to increased health expenditures, whereas higher unemployment is associated with reduced spending in this area. Surprisingly, the aging index did not show significant relationship with public health expenditures.

4.2 Model 2: determinants of immigration

Model 2 investigates the factors influencing immigration flows. Here, the lagged change in health expenditures per capita (Δ Health expenditures pc ($t-1$)) shows a significant positive effect on immigration (coefficient = 69.029, $p < 0.001$), suggesting that regions with higher health expenditures attract more immigrants. GDP per capita also has a positive and significant impact on immigration (coefficient = 4.996, $p < 0.001$), indicating that economic prosperity in a region may

draw more immigrants. However, the unemployment rate does not show a statistically significant effect on this model.

4.3 Model 3: immigration and spatially lagged health expenditures

Model 3 expands on the analysis in Model 2 by including a spatially lagged health expenditure variable (Δ W·Health expenditures pc ($t-1$)), which captures the influence of health expenditures in neighboring regions. The results reveal a strong positive effect of spatially lagged health expenditures on immigration (coefficient = 117.030, $p < 0.001$), indicating that health spending in neighboring regions can also attract immigrants. For the rest of predictors, results are similar to Model 2. The R^2 values indicate that Model 3 provides the best fit ($R^2 = 0.2289$) that Model 2 ($R^2 = 0.1793$) suggesting that including spatially lagged health expenditures improves the explanatory power of the model for immigration flows.

5 Discussion and conclusions

International migration is one of the great challenges to face by humanity around the world. Usually, migrants move to places where they have better conditions and quality of life, keeping in mind the work situation, since most voluntary migrants (legal or illegal) migrate during the adult stage of working age. Migrants are also those who do so involuntarily, either for reasons of refuge and asylum, or because they are involved in situations of human trafficking (Segal 2019).

The classic Malthusian theory (1798) already stated that an increase in demographic pressure would increase greater competition for resources and, consequently, a progressive impoverishment of population. In this article, the demographic pressure shown in the econometric analysis is due to an increase in foreigners.

The results from bivariate analyses at national level reveal significant shifts in migration patterns to and from Spain between 2008 and 2019. Notably, the composition of major migration partners has evolved, with Morocco maintaining its importance while countries like Colombia and Venezuela emerged as prominent sources, driven by political and economic crises. Spain's role as a net receiver of immigrants was consistent, with arrivals increasing from 599,074 in 2008 to 750,480 in 2019, alongside a modest rise in returns. Additionally, the decoupling of incoming and outgoing flows, evidenced by a sharp drop in correlation from 0.83 to 0.40, underscores a growing asymmetry in migration dynamics, with Brexit and the post-2008 economic downturn influencing return patterns from the UK and Romania, respectively.

Using regional data, the research questions proposed were confirmed for the econometric models analyzed because some relevant economic indicators, such as public health expenditure or GDP per capita, had a significative and direct relation with immigrant flows. These relationships have been proved bidirectional. These findings highlight a bidirectional relationship between immigration and health expenditures, where immigration levels influence health spending (Model 1), and

health spending—both within and across regions—affects immigration flows (Models 2 and 3). Additionally, economic prosperity (as measured by GDP per capita) consistently shows a positive association with both health expenditures and immigration, while regions with higher aging populations may attract fewer immigrants (de Haas et al. 2019; Burchardi et al. 2020; Venkataramani et al. 2020).

Migration theories consistently affirm that a favorable economic environment strengthens pull factors for immigrants. This is reflected in Models 2 and 3, which demonstrate that increases in GDP per capita positively influence immigration flows. It is typical for labor-driven migration, often by individuals of working age, to target regions with strong economic and employment prospects. For instance, during Spain's economic crisis from 2008 to 2016, outward migration increased significantly, with many immigrants returning to their home countries. This serves as a practical example of how economic conditions can directly impact migration patterns, reinforcing the connection between economic opportunity and migratory movements.

However, the lack of significance of the unemployment rate seems inconsistent with traditional theories such as the classic push–pull theory and labor market theory (Todaro 1969; Borjas 1990), which suggest that higher unemployment would typically deter immigration. One possible explanation for this finding is that other factors, such as regional economic prosperity or health expenditures, play a more dominant role in attracting immigrants, overshadowing the influence of the unemployment rate. Additionally, immigration may be driven more by specific job opportunities rather than overall unemployment levels.

It is also worth highlighting the inverse relationship found between the aging index and immigration, which is highly significant at the 1% level. This result indicates that as the aging index rises, the number of immigrants decreases. This result could be explained by the tendency of foreign immigrants to avoid regions with older populations, as they tend to concentrate in metropolitan or tourist areas (e.g., Madrid or the Mediterranean coast) where job opportunities are more abundant. This finding aligns with the spatial distribution of immigrant populations in Spain, who are drawn to regions with vibrant labor markets rather than aging, less economically active areas.

Nowadays, international immigration is a challenge that many countries need to face. It is a complex and multifaceted issue that involves economic, social, political and cultural considerations. One of the significant challenges of international immigration is the economic impact on both countries (the country of origin and the host country). Immigration can place strains on public services and resources in host countries, while also potentially contributing negatively to brain drain in countries of origin.

Socially, immigration can lead to cultural tensions, discrimination and integration challenges for both immigrants and host communities. Political factors such as border security, national identity and sovereignty also play a role in shaping immigration policies and attitudes toward immigrants. Raya Lozano (1999) commented about the contemporary racism from a perspective socio-anthropological, the importance of public policies on this subject and the lack of good comparative analysis to improve the social problem of immigration.

Addressing these challenges requires a comprehensive approach that considers the rights of immigrants, the needs of host communities and international cooperation. International immigration also can contribute to develop the economy in the host country, as immigrants should be integrated in the job market and the host society. Finding a balance that maximizes the benefits of immigration while mitigating its challenges is essential for creating a more inclusive and sustainable global society.

Spain is one of the countries that need to face these challenges, as the rest of the European Union. Its geographical location makes Spain an important entry route for population from Latin American and African countries. The Welfare State can help for the reception of population and the refugee's crisis during the current global conflicts in the world. But it is also needed to guarantee a strong national economy in the reception country to do it sustainable for the future, as for the host countries as for an international cooperation development in the migrant issuing countries.

Finally, the most important limitation for this research was the secondary sources. Each variable or indicator has its own methodology and, sometimes, it is difficult to get a balance data source because there is not enough historical data serial for international migration in Spain before the 2000s or they are not digitalized. Also, the large number of political and social changes for the recent history of Spain, for example in international migrations, does more complicated to reference the phenomenon.

For future research in this field, it would be favorable to develop the econometric models with more variables, to proof them in other countries or group of countries analyzing the results and, if there were available data, to extend the historical data serial for Spain.

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Declarations

Conflict of interest The authors declare they have no competing interests.

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