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ENSAYOS SOBRE DESAJUSTES ESPACIALES EN LA LOCALIZACIÓN DE LOS FACTORES PRODUCTIVOS REGIONALES Y EVOLUCIÓN ECONÓMICA REGIONAL

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A mi madre,

por su ejemplo de perseverancia y entrega.

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INTRODUCCIÓN

El objetivo general de esta Tesis es analizar la relación existente entre la localización de los factores productivos regionales y la evolución económica regional. En este contexto, el estudio de la población regional se convierte en el hilo conductor de los diferentes capítulos en los que se articula este trabajo. Para ello, en el Capítulo I, se analiza la existencia de desajustes espaciales entre los factores productivos y la población en las economías regionales europeas. Los movimientos interregionales de población tienen importantes efectos en el crecimiento económico regional. Estos efectos se deben a los cambios en las capacidades económicas regionales como resultado de los cambios en la localización de los trabajadores y los consumidores. Por otra parte, los movimientos interregionales de los factores productivos regionales (como la inversión de capital) podrían tener efectos significativos sobre las dotaciones económicas regionales. En teoría, los movimientos de los factores productivos tienden a reforzar o debilitar el proceso de convergencia económica entre regiones, favoreciéndola o perjudicándola. Con el fin de aportar pruebas empíricas sobre las ideas anteriores, en este Capítulo I se analiza desde una perspectiva exploratoria la evolución de los desajustes espaciales entre los factores productivos y la población lo que nos dará información acerca de la presencia de convergencia o divergencia entre ambas distribuciones a nivel regional. Desde la perspectiva empírica sería muy conveniente conocer el impacto del desajuste espacial en la localización regional de factores de producción sobre las disparidades regionales y sobre el crecimiento regional. El análisis de dichas influencias podría suministrar información significativa acerca de algunas cuestiones relevantes para el diseño de las políticas económicas regionales; específicamente, la interacción entre la distribución regional de factores de producción y su eficiencia (Berg et al., 2018).

La contribución de esta investigación a la ciencia económica regional se produce por dos vías, la exploratoria y la empírica. A través del análisis exploratorio del desajuste espacial se traslada la hipótesis tradicional de la desconexión espacial entre los puestos de trabajo y el resultado adverso del mercado de trabajo de las minorías en el contexto urbano[1] al regional. De manera más concreta, en el análisis empírico realizado, las

[1] Duncan and Duncan (1955), Taeuber and Taeuber (1965), Kain (1968), Holzer (1991), Inlandfeldt and Sjouquist (1998), Martin (2001, 2004) Gobillon et al (2007).

unidades de análisis serán las regiones europeas (NUTS-2)[2]. Esa modificación de la hipótesis tradicional del desajuste espacial (Sahin et al., 2014) se basa en las siguientes consideraciones. En primer lugar, se pasa del análisis del ámbito urbano al regional. En segundo lugar, la hipótesis es que, dado un sistema económico regional integrado dentro de un territorio superior (por ejemplo, un país), el desajuste entre la localización espacial de los factores productivos y la población determinaría el impacto final del trade-off entre eficiencia y equidad en la economía global (Ulltveit-Moe, 2007). Así, a través del análisis exploratorio, se podría detectar la existencia de convergencia/divergencia entre las distribuciones del factor productivo y la población y cuál es su principal causante. Ello permitiría diseñar políticas regionales acordes con los movimientos interregionales de los mismos que posibiliten la resolución del trade-off entre crecimiento económico y desigualdad. El análisis exploratorio se complementa con el estudio empírico derivado de la aplicación de la técnica de análisis de vectores autorregresivos (VAR). Dicho estudio muestra los efectos de los cambios en los desajustes espaciales entre la distribución de la población y del resto de los factores productivos sobre el crecimiento económico y sobre la desigualdad. De los resultados obtenidos se obtienen hipótesis acerca del probable comportamiento de ambos objetivos ante posibles recomendaciones de políticas económicas regionales.

Dado que los desajustes espaciales estudiados en el Capítulo I se traducen en cambios poblacionales a nivel regional, en el Capítulo II se lleva a cabo una propuesta para estudiar los componentes de los cambios poblacionales en las regiones españolas. Este tema ha venido a ocupar un lugar muy importante en los últimos años, puesto que las dinámicas demográficas vinculadas a dichos cambios se encuentran conectadas a ciertos territorios que han aparecido señalados recientemente tanto en las agendas académicas como políticas. Así, conceptos como “lugares olvidados”, “despoblación”, “lugares vacíos”, “lugares interiores” o el análisis de “regiones en contracción” son ejemplos de cómo la literatura especializada está abordando estos aspectos (los denominados “left-behind places” en la literatura anglosajona). Los lugares o territorios con una población creciente o en declive determinan el futuro de los habitantes, ya que las decisiones sobre instalaciones públicas, atención médica, educación o infraestructuras dependen en cierta medida de factores demográficos (Alamá-Sabater et al., 2021; Danko

[2] Amending regulation (EU) 2017/2391, Regulation (EC) No 1059/2003

y Hanink, 2017). También, la composición por edades de la población ayuda a dibujar la tendencia del cambio poblacional, convirtiéndose en responsable de las modificaciones y ajustes en las decisiones socioeconómicas y políticas relativas al mercado laboural, a la dotación de servicios y a la planificación urbana, entre otros (Antczak y Lewandowska-Gwarda, 2019).

El reto demográfico se ha convertido en una de las líneas de actuación política más relevantes para la mayoría de las administraciones públicas a diferentes niveles territoriales (local, regional, nacional, europeo). En el contexto europeo, la dinámica de la población, junto con los flujos de población, se están investigando en detalle como resultado de los desequilibrios territoriales. Se trata esencialmente de un tema regional que afecta a determinadas zonas de los países europeos. En particular, el estudio de las regiones europeas que experimentan estancamiento o declive poblacional es una línea de investigación relevante incluida en ESPON 2020[3]. Dentro de esta línea se aborda la contextualización espacial de la dinámica poblacional a través de la idea de “contracciones complejas” (complex shrinking), que considera la interacción de la geografía, la demografía y las diferentes variables socioeconómicas.

En este trabajo se amplía esa idea añadiendo una nueva dimensión: la interacción espacial de las áreas territoriales. Así, estudiamos en qué medida dicha interacción, en términos de cambio poblacional, podría determinar una nueva tipología territorial de áreas geográficas. La tipología propuesta podría encajar en las políticas relativas a la estrategia y reto demográfico. Algunos estudios (ver Agenda Valenciana Antidespoblament, 2017 y Bandrés y Azón, 2021) también están contribuyendo a analizar diferentes áreas centradas en el desarrollo local de territorios y clasificando regiones (NUTS-2) y municipios (LAU-2) según su riesgo de despoblación. Sin embargo, es de destacar que ninguno de los mencionados trabajos incorpora el entorno demográfico espacial de las regiones (su vecindario).

Desde el punto de vista exploratorio, el análisis del cambio poblacional a nivel regional puede detectar distintos patrones territoriales de comportamiento y, en consecuencia, la posibilidad de aplicar diferentes políticas para cambiar la dinámica poblacional de determinadas zonas. Por lo tanto, este análisis se podría enriquecer con el denominado Análisis Shift-Share Espacial (Spatial SSA) que permite identificar tanto las

[3] European Shrinking Rural Areas Challenges, Actions and Perspectives for Territorial Governance (ESCAPE)

influencias que el comportamiento de las regiones vecinas como los efectos indirectos generados por los flujos de población tienen en el cambio poblacional regional. La falta de consideración de la dependencia espacial de la población entre las provincias españolas limitaría la utilidad de la información derivada de los rankings de despoblación provinciales, y no permitiría involucrar a diferentes niveles de gobierno en las actuaciones relativas a la política demográfica. En España, estas políticas podrían abordarse a nivel nacional, regional o provincial, pero para que sean efectivas, convendría determinar en qué medida las dinámicas poblacionales son competencia de los diferentes niveles de gobierno. En este trabajo, consideraremos a la provincia como la unidad de análisis base, y se tendrán en cuenta las interacciones existentes entre las provincias vecinas (es decir, aquellas que tienen frontera común). Como resultado, se logrará considerar diferentes contextos espaciales (nacional, regional e interregional) lo cual permitirá una mejor comprensión de las responsabilidades entre los niveles de gobierno nacional y regional, facilitando la posible propuesta de recomendaciones de políticas socioeconómicas más eficaces.

Desde el punto de vista metodológico, nuestra propuesta mejora la perspectiva mostrada en Franklin (2014), puesto que incorporará la dimensión espacial que subyace en el enfoque metodológico mostrado en trabajos como los de Nazara y Hewings (2004), Ramajo y Márquez (2008), y Montanía et al (2021), entre otros. Nuestro shift-share modificado, añade elementos demográficos para contemplar las interacciones espaciales entre los mismos, permitiéndonos profundizar tanto en las fuentes de crecimiento de la población provincial española como en la contextualización del análisis de la dinámica de la población a partir de los patrones espaciales trazados a lo largo de las provincias. Además, el estudio se extiende a tres cohortes de edad: menos de 15 años, entre 15 y 64 años, y más de 64 años.

Por otra parte, la distribución de la población sobre el territorio da lugar a diferentes niveles de urbanización. Dicha distribución puede dar lugar a distintos efectos, positivos o negativos, sobre el crecimiento regional. De esta forma, en el Capítulo III se lleva a cabo un análisis econométrico de los efectos que las diferentes distribuciones de la población (urbana, semiurbana y rural) dentro de las provincias españolas tienen sobre el crecimiento económico provincial.

En el ámbito de la geografía económica son numerosas las investigaciones sobre la concentración de la actividad económica y su influencia sobre el crecimiento (Fujita y Thisse, 2002; Martin y Ottaviano, 2001; Fujita, Krugman y Venables, 1999). Muchas de ellas se centran en analizar los vínculos entre las zonas rurales y urbanas (Champion, 1998; Heins, 2004; Broersma y Dijk, 2008; Rivera,2009; Almeida et al. 2016; Aner, 2016), o la heterogeneidad del territorio y las diferentes formas de abordar el desarrollo de las regiones. En este sentido, son varios los autores que recurren a la hipótesis de Williamson (1965) para analizar la relación entre la aglomeración urbana y el crecimiento económico teniendo en cuenta el nivel de desarrollo de los países (Henderson, 2003; Wheaton y Sishido, 1981; Brülhart y Sbergami, 2009; Aroca y Atienza, 2012; Frick y Rodríguez-Pose, 2018). Según Williamson, cuando un país está aún por desarrollar, es deseable un alto nivel de concentración urbana ya que le permite ahorrar en los costes de infraestructura que implicaría acomodar más población en ciudades menos desarrolladas. Pero a medida que el país se desarrolla, la concentración urbana debería disminuir ya que la economía puede permitirse el coste de extender la infraestructura y el conocimiento a áreas del país más remotas. Además, las ciudades con mayor concentración se van congestionando y pierden eficiencia (Cuberes, 2020). Dicha hipótesis se enmarca en los modelos de economía urbana que definen a las ciudades como el resultado de un balance entre las ventajas asociadas a las aglomeraciones de población y sus costes, en lo que se conoce como el trade-off fundamental en economía urbana (Fujita y Thisse, 2002)

Otros trabajos como los de Castell-Quintana y Royuela (2014) analizan los efectos de la desigualdad de ingresos y la aglomeración en el crecimiento económico de los países a largo plazo, por lo que consideran que ambos procesos interactúan con el crecimiento. Como medidas de aglomeración utilizan tasas de urbanización y de concentración urbana (índices de primacía), entre otros indicadores. Estos autores se centran en análisis de la desigualdad en relación a las aglomeraciones urbanas. La relación de estas con la desigualdad revela resultados diferentes según esta sea mayor o menor en el país. Si hay baja desigualdad, el aumento de la aglomeración genera efectos positivos, pero si es alta, las deseconomías de congestión superan a los beneficios de la concentración urbana.

Además, se introduce en el estudio el nivel de ingresos del país, Como dichos resultados también vienen condicionados por el nivel de ingresos del país, ya que si son países de bajos ingresos, y baja desigualdad un aumento de esta se correlaciona positivamente con el crecimiento subsiguiente, pero si son países de altos ingresos y alta desigualdad la correlación es negativa, estos autores concluyen que la influencia de la desigualdad y la aglomeración en el crecimiento económico no solo depende de los niveles iniciales de los mismos sino de su evolución, debiendo tener también presente en los países, los niveles de ingresos y su distribución.

La OCDE (2009a, b, c) propone como estrategia mejor que la concentración, un sistema urbano más equilibrado, en el que ciudades pequeñas y medianas desempeñan un papel fundamental en la movilización de activos locales para explotar las sinergias locales. Para el Banco Mundial (2009), aunque la concentración urbana mejora el crecimiento económico, en los países en desarrollo también provoca un aumento de la desigualdad, por lo que debe revisarse como les afecta.

Partiendo de la heterogeneidad del territorio y dado el nivel de desarrollo económico, en nuestro estudio nos cuestionamos si las regiones urbanas, semiurbanas y rurales se desarrollan a diferentes velocidades. Para ello, en el capítulo III determinaremos la estructura de población regional tanto urbana como semiurbana que maximiza el crecimiento económico de cada territorio. De este modo, se recoge la interacción entre dos variables, por un lado, la elasticidad del crecimiento del PIBpc respecto a un tipo de población concreta (urbana o semiurbana) y por otro, el PIBpc de todas las regiones a diferentes niveles. Concretamente, queremos saber si el tipo de urbanización de una región le está ayudando a no quedarse atrás.

En definitiva, nuestras conclusiones se dirigen a determinar, dado un nivel de desarrollo del país, el tamaño de población urbana o semiurbana que optimiza el crecimiento económico de la región. Los trabajos de Frick y Rodríguez-Pose, (2018); Rodríguez-Pose y Griffiths, (2021), evidencian que son las ciudades de tamaño mediano las que más contribuyen al crecimiento de la región, conectando con las teorías de las ciudades-red (Camagni, Capello, y Caragliu, 2015; Capello, Caragliu, y Fratesi, 2015; Navarro-Azorín, y Artal-Tur, 2017). Estas ciudades de tamaño mediano se salvan así de la paradoja de Todaro (Harris y Todaro, 1970), que explica la relación entre alta densidad de población y altos niveles de desigualdad cuando lo que se espera es que urbanización y desarrollo vayan de la mano y por consiguiente una menor desigualdad en las regiones de mayor densidad.

La OCDE (2009a, b, c) y Barca et al. (2012) no solo destacan el papel de las aglomeraciones urbanas, también resaltan el papel de las aglomeraciones semiurbanas y/o periféricas en el crecimiento de los territorios. Del mismo modo, Duranton y Puga (2000) subrayan la importancia del “sistema de ciudades” global en los países desarrollados, donde tienen cabida tanto las ciudades grandes y diversificadas como las más pequeñas y especializadas.

Entre los factores determinantes de los cambios poblacionales, el empleo y la actividad económica son elementos clave. El carácter endógeno de estas variables precisa que las dinámicas población-empleo sean abordadas con una metodología especifica que contemple esta relación. De esta forma, en el Capítulo IV se especifica y estima un modelo econométrico que permite analizar cómo la distribución del empleo dentro de una región afecta a la localización intrarregional de la población, y viceversa (Carlino and Mills, 1987, Boarnet, 1994 y Hoogstra, 2017). La aplicación de dicho modelo se realiza para el caso de los municipios que integran la región de Extremadura.

Los procesos de despoblación están condicionados en gran medida por elementos relacionados con la economía. El empleo, el dinamismo económico de un territorio o la especialización sectorial y su capacidad para generar valor añadido, vienen a explicar gran parte de los problemas a los que se enfrentan los territorios en la actualidad y que a su vez son también el origen de estos procesos. Empleo y población se convierten por tanto en variables clave con los que analizar el complicado entramado de relaciones que explican la situación de despoblación que afecta a una gran parte del territorio, así como a un alto porcentaje de municipios.

La relación entre ambas variables ha sido objeto de extensa investigación. Antes de Carlino y Mills (1987), Steinnes y Fisher (1974) y Steinnes (1978) exploraron la simultaneidad entre la población y el empleo en la localización territorial. Sin embargo, fue el modelo propuesto por Carlino y Mills el que tuvo un impacto significativo en el ámbito académico. Dicho modelo analiza los factores determinantes de la variación de la población y del empleo en un territorio a partir de un sistema de dos ecuaciones, es decir considerando ambas variables endógenas. Otros trabajos han ampliado el modelo original introduciendo en el análisis el concepto de área local de empleo mediante la consideración de las relaciones de dependencia espaciales (Boarnet, 1994; Decressin y Fatas, 1995; Deitz, 1998; Henry et al. 1999; Mulligan et al. 1999; Feser e Isserman, 2006, 2017; Hoogstra et al., 2017; Alamá et al.,2022 a, 2022b).

Tomando como referencia los municipios, en este trabajo consideramos que las variaciones del empleo y de la población de un determinado municipio están influenciadas tanto por los flujos de población y empleo del propio municipio como de los municipios de alrededor (área local de empleo), pudiendo diferenciar entre efectos propios y efectos indirectos. Además, se distingue entre el nivel de urbanización de los municipios, (Feser e Isserman, 2006, 2017; Alamá et al., 2022b).

El objetivo es identificar las relaciones que más contribuyen al desarrollo de los territorios, por lo que este tipo de análisis nos permitirá focalizar el estudio en las áreas rurales y detectar en qué medida la proximidad a los núcleos urbanos y semiurbanos puede contribuir a modificar la dinámica, tanto de población como económica de las zonas en declive. Para ello, nos centramos en los efectos indirectos o spillovers que se generan entre los municipios y su área local de empleo (influencia), obteniendo así información sobre las relaciones intermunicipales que más capacidad de influencia tienen sobre dichos municipios. Dicha información podría fundamentar directrices en materia de política económica.

Nuestro modelo se basa en un sistema de dos ecuaciones (Carlino y Mills, 1987), donde además de las variables endógenas situadas en el lado izquierdo de la ecuación, crecimiento de la población y del empleo, también se introducen, en el lado derecho, el crecimiento de empleo y de la población en los municipios vecinos, definidas a través de la matriz de pesos (W) que recoge la estructura vecinal.

La especificación del modelo permite determinar los efectos indirectos generados entre los diferentes municipios en función de su nivel de urbanización (DEGURBA project, Eurostat, 2014)[4]. De esta forma se captura la relación empleo-población teniendo en cuenta la heterogeneidad territorial y cuantificando los efectos que un aumento del empleo en una zona urbana o intermedia puede tener sobre un municipio rural.

Nuestra principal hipótesis es comprobar si los efectos espaciales (spillovers) generados por las relaciones interterritoriales entre municipios son independientes del nivel de urbanización, o si el desarrollo económico de los municipios está afectando a esos efectos espaciales.

Para ello se estiman distintos modelos. En el primer modelo no distinguimos el nivel de urbanización de los municipios, por lo que se considera que son homogéneos. En el segundo modelo, tenemos en cuenta la heterogeneidad de los municipios vecinos,

[4] Dijkstra, Lewis y Hugo Poelman. "Documento de Trabajo Regional 2014". Una definición armonizada de ciudades y zonas rurales: el nuevo grado de urbanización. WP1 (2014): 2014.

clasificándolos en rurales, urbanos y semiurbanos. De esta forma, los resultados de las estimaciones nos permitirán determinar las relaciones interterritoriales entre un municipio y los vecinos, en función de su nivel de urbanización. En el último modelo, consideramos la relación interterritorial teniendo en cuenta el nivel de urbanización de los municipios en los que se origina el efecto y de aquel en el que recae el efecto. En los tres modelos, los resultados coinciden en destacar que, si aumenta el empleo en un municipio, la población de este aumenta ("people follow jobs").

El conocimiento del funcionamiento de estos modelos justificará que la política territorial se dirija a los centros de empleo con mayores efectos de dispersión sobre el territorio.

CHAPTER 1. EVALUATING THE SPATIAL MISMATCH BETWEEN POPULATION AND FACTOR ENDOWMENTS: THE CASE OF THE EUROPEAN UNION

1.1.- Introduction

Economists and other social scientists have long noted that the degree of factor mobility is greater between regions within a country than between countries. The topic has received considerable attention for some decades (e.g. MacDougall, 1960; Davis and Weinstein, 1999) from opposing perspectives, since on the one hand, neoclassical theory predicts that trade and factor mobility will lead to the disappearance of regional disparities in the long run, while the New Economic Geography (NEG) argues the opposite: free competition and factor mobility will favour regional disparities (Granato et al., 2015). Whichever view is taken, regional factor mobility can be seen as one of the most important mechanisms for the adjustment of regional economic imbalances (Begg, 1995). In this way, the interaction of such regional factors, understood as regional inputs combined in specific regions within a country, can alter both interregional equity and aggregate growth.

Given the importance of this mechanism, it should be taken into account the traditional debate on spatial equity vis-à-vis economic efficiency (e.g. Richardson, 1979; Martin, 2008; Cerina and Mureddu, 2014)[5]. Nevertheless, in the literature on the relationship between interregional inequality and economic growth (Williamson, 1965; Brülhart and Sbergami, 2009; Alexiadis and Eleftheriou, 2011; Piketty, 2014), the vast majority of studies have ignored how the regional allocation of productive factors might affect spatial equity and the aggregate growth of the regional economic system.

Therefore, and according to this literature, we are confronted with discrepancies or mismatches between the location (and mobility) of production factors vis-à-vis the location of the population. In this context, we propose to evaluate the existence and evolution of this imbalance by considering the tools used in other approaches that explicitly contemplate the presence of spatial mismatches. Specifically, we develop a link

[5]Conventional wisdom tends to support the view according to which the optimal strategy to maximize global income might be to cluster production factors within the most productive regions (Ottaviano and Thisse, 2002; Rahman, 1963; Takayama, 1967), which can come to the detriment of regional equality.

between the literature on regional factor mobility and the so-called spatial mismatch hypothesis (Kain, 1968)[6], which suggests that economic growth and job opportunities tend to be concentrated in certain regions or cities, leading to a concentration of skilled labour and capital in those territories (for reviews, see Kain, 2004; Glaeser et al., 2004; Gobillon et al., 2007)[7].

Our study shifts the traditional hypothesis of a spatial mismatch from the urban context, which proposes a spatial disconnection between jobs and the adverse outcome for the minority labour market, to the regional one, taking the regions as the units of analysis. Therefore, our variant of the spatial mismatch hypothesis will shift the analysis from the urban to the regional level. According to our approach, it would be argued that opportunities for people living in less developed regions are located far away from these regions. This would be the case of the so-called left-behind regions (Pike et al., 2023). Secondly, we also hypothesise that, by considering a regional economic system as part of a larger territorial organisation (e.g., a country), the distance between the regional location of production factors and the population will determine the trade-off between efficiency[8] and equity in the country (Farber, 2012). In this regard, several regional initiatives set up by the EU and national European governments have been implementing regional redistributional policies, seeking to reduce regional inequalities by encouraging relocation of activity to the periphery. However, one might question if other policy initiatives could be more efficient—for instance, regional policy initiatives relying on direct income transfers (Ulltveit-Moe, 2007).

Overall, considering the spatial mismatch hypothesis can be a useful framework for understanding how disparities in job opportunities, productive factor endowments, and economic growth are increasing, generating depopulation and limiting opportunities in less prosperous regions. Ultimately, it can help to explain why some regions have lost relevance in the regional economic system for many decades now (Rodríguez-Pose, 2018). By identifying the patterns of spatial mismatch, some structural barriers to

[6] See also the pioneering contributions by Duncan and Duncan (1955) and Taeuber and Taeuber (1965).

[7] When originally formulated, the spatial mismatch hypothesis supported the view that Black workers faced difficulties in finding good jobs because they lived in segregated zones that were far from (and poorly connected to) major economic centers (Gobillon et al., 2007).

[8] In this paper, efficiency should be understood as the ability to use regional inputs to achieve maximum aggregate growth.

economic growth can also be detected, and policymakers can work to develop targeted interventions that promote economic development and job growth in backward territories.

Other researchers have suggested the interregional mobility of other factors as an alternative source of spatial adjustment (see for example Eichengreen, 1992; Decressin and Fatás, 1995; Cheshire and Magrini, 2002). Martin (1999) also refers to the mobility of productive factors between regions and sectors to address the market failures caused by the generation of negative and positive externalities. On the one hand, workers would suffer less from the effects of the location decisions of firms, and on the other hand, it would promote the spatial dispersion of innovation activities, thus eliminating the location of technological spillovers. His belief is in line with the new theories emerging from neoclassical thinking (Barro and Sala-i-Martin, 1991). Thus, the movement of population from one region to another has important implications for regional growth due to changes in regional capacity as a result of both consumers and workers. In the European Union context, these trends might also be affected by some countries' anomalies in the spatial distributions of their populations (Gutiérrez et al., 2023).

Taking these considerations into account, our paper aims to examine the existence of spatial mismatches between productive factors and populations in European regions, focusing on how these imbalances might affect regional disparities and growth. Regional income disparities have been explicitly addressed through the EU regional and urban development policies, usually referred to as EU cohesion policy, the importance of which is reflected in both its monetary volume (one-third of the EU budget) and its multilevel nature, since central, regional and local governments are co-responsible for their implementation (Di Caro and Fratesi, 2022). Moreover, the relevance of the European Union Cohesion Policy has led to this policy being motivated by different regional economic theories (Dotti et al., 2024, for a review). Even though the pillars of this policy date back to the 1988 reform of the structural funds (Fratesi and Wishlade, 2017), inequalities across EU regions are still profound and persistent. Although in the process of economic integration such as the European one, the removal of obstacles to the free movement of goods and/or factors should by itself cause convergence of living standards (Puga, 2002), this has not been the case, partly due to low mobility—even within European countries, cross-regional migration is still low. However, the convergence of the living standards argument does not take into account that migration implies a loss of productive factors that penalise the long-term development of the affected regions.

Our research proposes to calculate the so-called Spatial Mismatch Indices for capital stock and labour with respect to the distribution of population across regions. These indices represent the percentage of the population of a regional economic system (in our case, the EU) that must move to other regions for the distribution of population and the regional production factor across regions to be identical. Later, we consider that new insights into regional policy issues can be gained by analysing the impact of spatial imbalances on the distribution of production factors and their impact on regional disparities and growth. In particular, this analysis allows us to explore the relationship between the distribution of production factors and their efficiency. Indeed, as indicated by Ulltveit-Moe (2007), "it is alarming to find that despite devoting considerable resources to regional policy, the evidence would suggest that neither efficiency gains nor reduced regional inequalities have resulted".[9]

In a second stage, we test our spatial mismatch hypothesis, according to which less developed countries experience poor regional outcomes because their populations are disconnected from labour and physical capital production factors. Using a vector autoregressive (VAR) methodology, we attempt to evaluate if European regional growth and inequality can be related to the existence of spatial mismatches between population and both labour and physical capital.

Our contribution is naturally related to the growth accounting literature (Hulten, 2010; Crafts and Woltjer, 2021). Since the seminal works of Solow (1956; 1957; 1962), growth accounting has provided a framework to decompose the observed output into two components: (i) the contributions due to changes in factor inputs; and (ii) the residual that cannot be accounted for by changes in input use (Gong, 2020), which is usually measured by an increase in total factor productivity (TFP). Therefore, this framework is the most widely used when attempting to measure the contribution of factors of production to growth (Cette et al., 2022) and, as such, has strong links with the issues we deal with in our paper. Indeed, the fact that the growth accounting literature acknowledges that factors of production cannot fully explain economic output (and, therefore, for inputs and outputs

[9] From another perspective, this paper also contributes by extending the traditional hypothesis of the Carlino and Mills's (1987) model, which relates the existing movements between employment and population. Thus, given that the hypothetical aggregate function that captures the regional output outcome includes both labour and the stock of physical capital, we include the stock of physical capital to assess hypotheses à la Carlino-Mills, of the type "(physical) capital follows people" or "people follow (physical) capital".

to balance, TFP must be derived as a residual), provides a direct link with our approach, which also makes advances in this direction, as we focus on other explanations—in our case, the spatial mismatches between factors of production themselves.[10]

Our results confirm the existence of a clear discrepancy in terms of spatial mismatches between the distribution of the population and the productive factors (labour and stock of capital) within the two types of European countries considered: cohesion and non-cohesion countries. Thus, European countries with cohesion regions could be inadequately exploiting the connection opportunities deriving from a match between people and productive factors. These findings, corroborated by the second-stage analysis (VAR), suggest that a strategy to stimulate European growth would be insufficient to overcome the territorial gaps in Europe, and that more investments in physical capital and employment opportunities would be most conducive to mitigating regional inequalities. As a result, policies aimed at addressing lagged regions should prioritise correcting these spatial mismatches.

The remainder of the paper is organised as follows. Section 2 describes the methodology. The data and the empirical approach are detailed in Section 3. Section 4 presents estimation results and explores influences of spatial mismatch in the regional allocation of production factors on regional disparities and growth. Finally, Section 5 concludes.

[10] We thank one of the anonymous reviewers for this comment. In the literature, it is common to encounter agglomeration-oriented policies that consider the agglomeration of regional productive factors as a key driver of economic growth and innovation (see Krugman, 1991). This approach focuses on the concentration of economic activities and resources within specific geographic areas, leading to the clustering of industries, firms, and skilled labour. This literature emphasizes the benefits of spatial proximity, such as knowledge spillovers, economies of scale, and easier access to markets and specialized inputs. Policies based on this approach often aim to promote clustering and agglomeration to stimulate regional economic growth and innovation.

On the other hand, the approach proposed in this paper (the mismatch between regional productive factors and regional populations) focuses on the spatial distribution of production factors, such as labour and physical capital, in relation to the distribution of population across regions. This approach highlights mismatches between the regional availabilities of productive resources and the regional population endowments. It suggests that mismatches between production factors and population can hinder economic development and exacerbate regional inequalities. Policies based on this approach may aim to address these mismatches by, for example, investing in infrastructure or implementing targeted employment policies.

In summary, while the agglomeration of regional productive factors approach emphasizes the benefits of concentration and clustering, our approach (based on the mismatch between regional productive factors and regional populations) focuses on the consequences of how productive factors (labour and physical capital) are distributed among the regions within a country.

Krugman, P. (1991). "Increasing Returns and Economic Geography." Journal of Political Economy, 99(3), 483-499.

1.2.- Methodology

Although the regional science and economic geography literatures have grown rapidly in recent decades, few contributions have explicitly explored the relationship between potential spatial imbalances in the regional distribution of productive factors and their impact on economic inequality and regional growth (Panzera and Postiglione, 2022). According to Magrini (2004), the mobility of productive factors plays an important role in regional growth, but this aspect is often neglected in the literature on regional convergence. Attention should be given to labour mobility, particularly in those places where it is low, which is usually the case in European regions compared to their US counterparts. In this regard, and as shown by Blanchard (1991), labour mobility has emerged as an essential factor in the convergence of per capita income among American states.

Following these arguments, the methodology we propose aims to show whether changes in the distribution of the different factors of production lead to convergence or divergence in the distributions of both the population and each of the factors of production. It also examines whether changes in the population reinforce or compensate for the effects of changes in the factors of production. To do this, a spatial mismatch index is used as a starting point. Specifically, the spatial mismatch index (hereafter SMI), which takes into account the degree to which the different productive factors and the population are regionally distributed, provides an approximation of the percentage of the population that would have to move in order for the distribution of a given productive factor to be identical to the distribution of the European population. These ideas had been partly considered, from a different perspective, by Sahin et al. (2014), among others, who examined the causes of the mismatch between labour supply and demand in the US, concluding that the lack of overlap between job vacancies and the unemployed in the labour market for geographical reasons was irrelevant—although others such as Moretti (2012) pointed out that geography actually mattered[11]. Therefore, this relevant literature was also considering implicitly the relevance of the spatial or "geographical" mismatches, although in a different setting.

[11] As they found empirical evidence showing that the interpersonal diffusion of uncodified knowledge decreased with distance.

The fundamental basis for our analytical development is the index of spatial mismatch developed in Martin (2001), and later refined in Martin (2004). This index is based on the measure of dissimilarity used to analyse residential segregation proposed by Duncan and Duncan (1955) and Taeuber and Taeuber (1965). However, as indicated in the introduction, the first hypothesis on this index was posed by Kain (1968), who examined the issue of whether the decentralisation of work in US cities contributed to lower incomes and higher unemployment rates among Black American households.

As a novelty in our study, we propose an alternative use of this index to analyse the spatial mismatch of the different production factors in relation to the population, assessing the convergence or divergence between the distributions of these factors and the population.

The expression corresponding to the spatial mismatch index that we use is as follows:

$$SMI_k = \frac{1}{2P}\sum_{j=1}^{J}\sum_{i=1}^{N}\left|\left(\frac{f_{ij}}{F_j}\right)P - p_i\right| \qquad (1)$$

where P is the total population (in our application the total population in the European Union), i is the region indicator, $i = 1\ldots,N$ (N being the number of European NUTS-2 regions), and j the country indicator, $j = 1\ldots, J$ (J being the total number of countries in the EU).

The productive factor of each region is represented by f_{ijk} (k being the productive factor indicator), while F_k represents the productive factor k in the EU28, which in our application will be either employment or the physical capital stock.[12] Finally, the population of each region is also included, represented by p_i. Each of the spatial mismatch indexes SMI_k, obtained for each production factor k and each sample year t,[13] represents the percentage of population of a regional economic system (in our case, the EU) that must move to other regions for the distribution of population and the regional production factor across regions to be identical. Adopting the perspective for each of the countries considered, these population flows can be both positive (outflows) or negative (inflows).

[12] The analysis will be extended beyond the production factors, considering also GDP.

[13] We drop the time indicator, t, for a simpler notation.

We calculate the SMI_k yearly for our sample period and, therefore, the results allow us to detect the population trends vis-à-vis the productive factor. A decreasing trend will indicate that the two distributions are converging, while an increase of the index over time will denote that the population and the production factor are diverging. The Total Change $(SMI_{t+1} - SMI_t)$ tells us whether there is convergence (negative total change) or divergence (positive total change). If SMI_k is decreasing (increasing) over time, the convergence (divergence) of population and the production factor could be due to a shift in population and/or a shift in a productive factor.

To identify the likely drivers of the convergence or divergence process, we follow Martin (2004) and calculate the mixed or dynamic variant of the spatial mismatch index. The mixed variant, $SMIMIXED_{k,t}$, is derived as the basic index $SMI_{k,t}$, but the production factor is the one corresponding to t+1. Therefore, the mixed (or dynamic) spatial mismatch indices represent the percentage of population of a region that must move to other regions for the distributions of population in t and the regional production factor across regions in t + 1 to equalise. The interest of this index is operational, since it allows us to decompose the total change $(SMI_{t+1} - SMI_t)$ into two parts, identifying to what extent the total change can be attributed to the change in the productive factor or to the change in population. The expression corresponding to the mixed spatial mismatch index is as follows:

$$SMIMIXED_k = \frac{1}{2P} \sum_{j=1}^{J} \sum_{i=1}^{N} \left| \left(\frac{f_{ij,t+1}}{F_{j,t+1}} \right) P_t - p_{i,t} \right| \quad (2)$$

The comparison of *SMI* and *SMIMIXED* reveals to detect to what extent it is the shift in the population or in the production factor that contributes more to the convergence or divergence of the two distributions. For this, we can derive the following expression for each production factor *k*:

$$FPCH_{k,t} = SMIMIXED_{k,t} - SMI_{k,t} \quad (3)$$

In Equation (3), $FPCH_{k,t}$ represents the change in the *SMI* resulting from a shift in the productive factor, thus, indicating the impact of production factor *k* shifts on *SMI*. Therefore, it tells us whether the shift in the production factor tend to create convergence or divergence between the regional distributions of populations *vis-à-vis* the factor of production. A negative value would indicate that the production factor in *t + 1* is lower than in t and, therefore, the shift of the production factor contributes to reduce the *SMI* in *t+1*, and the population and the production factor converge. If Equation (3) is positive, the production factor increases between t and *t+1*. Therefore, the shift of the production factor contributes to increase the *SMI* in *t+1*, resulting in divergent distributions.

Analogously, we can determine the extent to which changes in population contribute to the convergence or divergence process with the distribution of the production factors. This can be formulated as follows:

$$POPCH_{k,t} = SMI_{k,t+1} - SMIMIXED_{k,t} \qquad (4)$$

where $POPCH_{k,t}$ indicates the extent to which population changes in t caused a convergence or divergence in the distribution of population and production factors. If the result yielded by Equation (4) is positive, then population change between t + 1 and t is positive, hence population shifts contribute to increase the *SMI*, and the distributions of population and the production factor diverge. In contrast, if the result yielded by Equation (4) is negative, then population change between t and *t + 1* is negative, leading to a decline in the *SMI*, and the two distributions tend to converge.

The sum of equations (3) and (4) determine the total change in the spatial mismatch index between t and *t+1*. In this case, according to the results yielded by equations (3) and (4), production factor shifts, or population shifts could offset each other and, depending on the magnitude of the shifts, either component might prevail when evaluating the differences between the two distributions. This can be represented as follows:

$$TCHSMI_{k,t} = FPCH_t + POPCH_t \qquad (5)$$

where $TCHSMI_{k,t}$ represents the total change in *SMI* for production factor k between t and *t + 1*. This expression is key when identifying the likely drivers of the convergence or divergence process.

We conclude this section by stressing the theoretical importance of the mobility of the main productive factors, labour and capital, as determinants of regional economic growth and convergence. Moreover, in a broadly competitive market, capital and labour are more mobile between regions than between countries, since regional economies tend to operate within a common system (legal, political, and institutional), a common language and a common cultural framework (McCann, 2001). The rest of the paper empirically analyses the relationship between the distribution of the various productive factors and the population to explore the interrelationships between these distributions, economic growth, and inequality growth.

1.3.- Data and sources

In order to obtain homogeneous series on the productive factors, we use the Cambridge Econometrics European regional database, which provides information at the regional level for 28 European countries for the 2000-2020 period. Its main source is the Eurostat REGIO database, and the information is supplemented by the AMECO database and Eurostat.[14] The variables selected are gross domestic product (GDP), population, employed population, unemployed population. Regional capital stock was estimated using the perpetual inventory method (PIM). The data used are a panel of 263 NUTS-2 regions in 28 EU Member States for the 2000-2009 period. Descriptive statistics on the selected variables and the countries in our sample are reported in Table 1.1.[15]

[14] AMECO is a dataset provided by the Directorate-General for Economic and Financial Affairs of the European Commission - DG EcFin. Specifically, it is the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs.

[15] Regarding the estimation of the capital stock, we used the perpetual inventory method (PIM), based on the following equation:

Kt=(1-δ)Kt-1+GFCF

where K is real net capital stock, stands for the depreciation rate (5%), and GFCF is real gross fixed capital formation (GFCF).

The perpetual inventory method (PIM) needs an initial capital stock value at regional level (i), and was estimated considering the initial capital stock at country level KN,0 (AMECO) weighted by the average share of total GFCF in region i within total GFCF at the country level over the entire period (Regional capital stock estimates, Methodological note, Cambridge econometrics):

$$K_{i,0} = \frac{\sum_t GFCF_{i,t}}{\sum_t GFCF_{N,t}} \times K_{N,0}$$

Table 1.1 Basic variables, European regions, descriptive statistics, selected years

Variable	Year	Mean	Std Dev.	Min	Max
Capital Stock[a]	2000	124,529.2	149,215.2	3,146.6	1,547,144
	2010	156,970.3	183,066.5	4,286.7	1,970,445
	2019	119,373.6	210,003.1	5,079.97	2,377,116
Employment	2000	786,166.6	653,513.3	15,900	5,846,364
	2010	823,020.3	693,640.5	17,657	6,021,598
	2019	882,597.3	749,761.6	19,470	6,5514,609
GDP (constant)[b]	2000	44,160.24	51,134.02	1,139.68	519,518.7
	2010	51,175.45	59,335.46	1,328.18	635,063.5
	2019	58,862.79	67,752.74	1,382.4	729,187.1

a In Millions of Euros (Constant prices, 2015)

b In Millions of Euros (Constant prices, 2015)

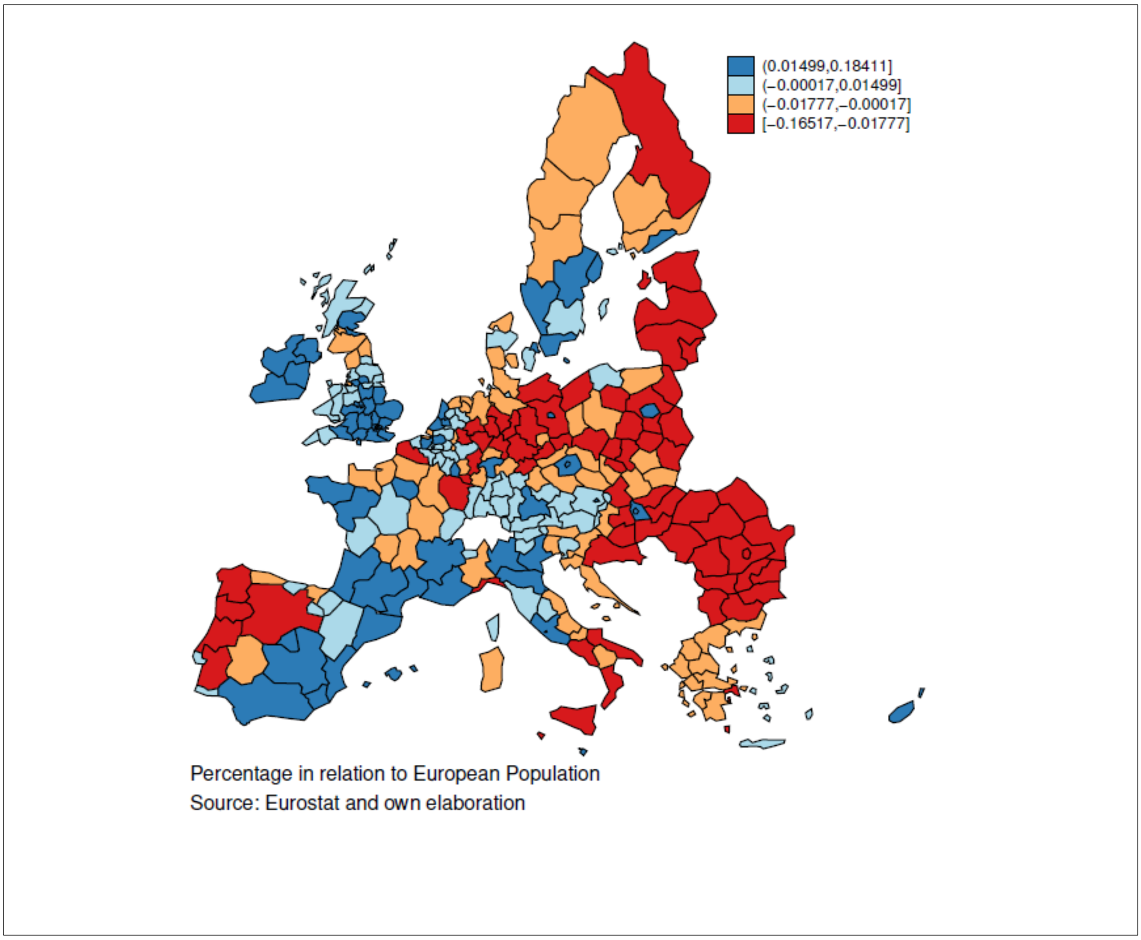
Source: Own elaboration with AMECO and EUROSTAT data

As for the population variable, Figure 1.1 shows its changes across European regions during the sample period. As depicted on the map, population flows seem to be strongly influenced by economic factors, as rich regions, or those with high-growth profiles, receive more migrants. For instance, in the case of Spain, rich regions such as Madrid and Barcelona, and others whose economic activity levels have increased during the examined period (e.g., Andalusia and the Valencian Community), most counties in the United Kingdom,[16] French regions located in the Mediterranean and the Atlantic Coast of France (e.g., Rhône-Alpes, Île-de-France, Languedoc-Roussillon), regions in the north of Italy (e.g., Lombardia, Lazio), several government regions of Germany (mostly located in West Germany), or the three NUTS-2 Republic of Ireland regions. In contrast, regions with lower economic development or prospects have experienced declines in their EU population shares.[17]

[16] Although NUTS-2 regions in the UK do not have an exact match with counties

[17] This might also include not necessarily poor regions but also some sparsely populated areas of the EU, particularly in Finland.

Figure 1.1 Population changes 2000-019, European regions (NUTS-2)



These patterns in the changes of regional population could be determined by the relationship between population movements and economic opportunities, emphasizing the need to address disparities in regional development and prosperity for a more equitable distribution of resources and opportunities across Europe. Understanding these dynamics is critical for informed decision-making that supports the well-being of communities and contributes to the stability of the region as a whole.

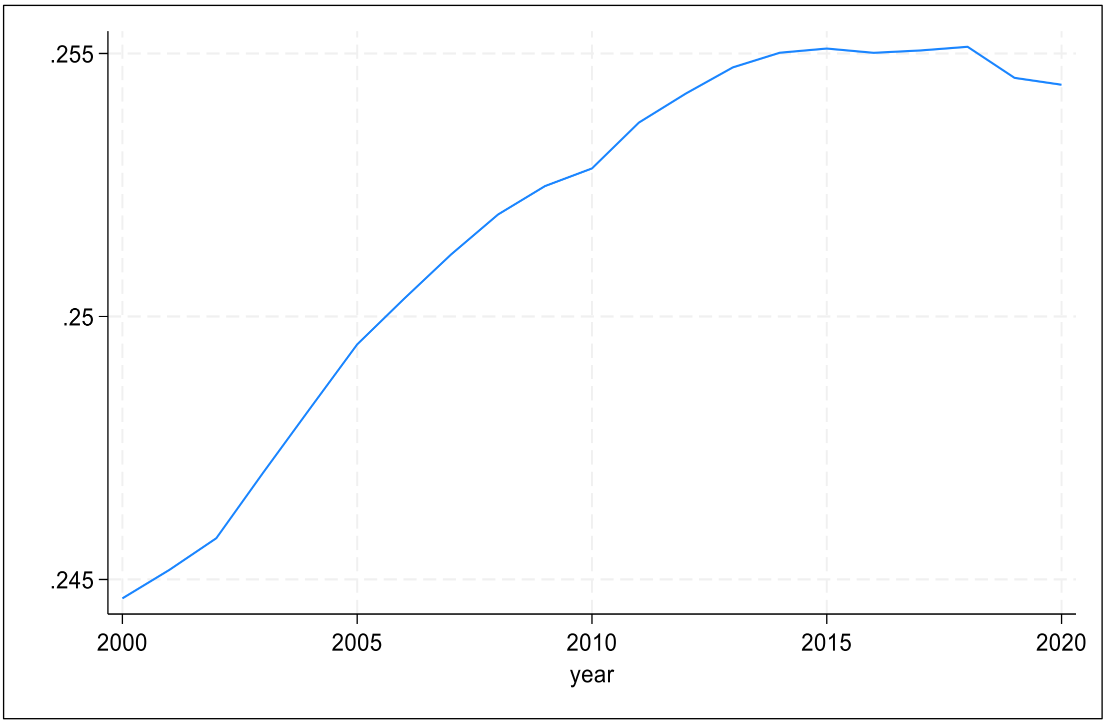
The Theil index[18], which we present in Figure 1.2, quantitatively confirms the previous assessments. The results show a clear upward trend in inequality in regional

[18] The Theil index is defined as:

$$T = \sum_{i=1}^{N} \frac{x_i}{\bar{x}} \times ln\left(\frac{x_i}{\bar{x}}\right)$$

population trends over the period analysed. This trend indicates the absence of a regional redistribution of population, or what is equivalent to an increase in the degree of regional concentration of population. In 2015, this increasing trend reached a plateau, and inequality has even declined since 2018, pointing to a slight improvement in the spatial distribution of population.

Figure 1.2 Theil inequality index for European regional population (NUTS-2), 2000-2019



Source: Own elaboration

This growing inequality in the distribution of population among European regions is a cause for concern, as it exacerbates the problems associated with left-behind places (Rodríguez-Pose, 2018). The patterns these trends reveal provide important insights into the imbalances with respect to the factors of production. By examining the relationship between population movements and economic factors, we can gain a deeper understanding of the underlying forces that shape regional development and prosperity. This information can be used to identify areas in need of support and to develop strategies

where xi is the value of the population for European region i, x is the average of population for European regions, and N is the total number of European regions.

for promoting a more equitable distribution of resources and opportunities across Europe. It is crucial to understand the behaviour of the distribution of population[19] among European regions to make informed decisions and to achieve a more sustainable and prosperous future for all Europeans. The increasing inequality in population distribution highlights the need for a thorough analysis of the mismatch between population distribution and the factors of production.

1.4.- Results

This section performs an analysis of the disparities between regional production factors and the population, following the theoretical guidelines outlined in Section 2 and methodology presented in Section 3. Focusing on the European Union context, we analyse the extent to which production factors and population converge or diverge across European regions over the period analysed (2000-2019), and how these patterns affect regional growth and inequalities.

1.4.1.- Spatial mismatch indices: magnitude and evolution

Regarding the spatial mismatch index (SMI), which we also calculate for the period of analysis, a decrease should be interpreted as a convergence between the distributions of population and production factors across European regions. Conversely, an increase should be interpreted as divergence. Following the rationale provided above, we calculated the SMIs for capital stock and labour in relation to the distribution of population across regions. The evolution of these SMIs will reveal whether the shifts in the distributions of population and production factors exhibit a pattern that is convergent, stagnant, or divergent.

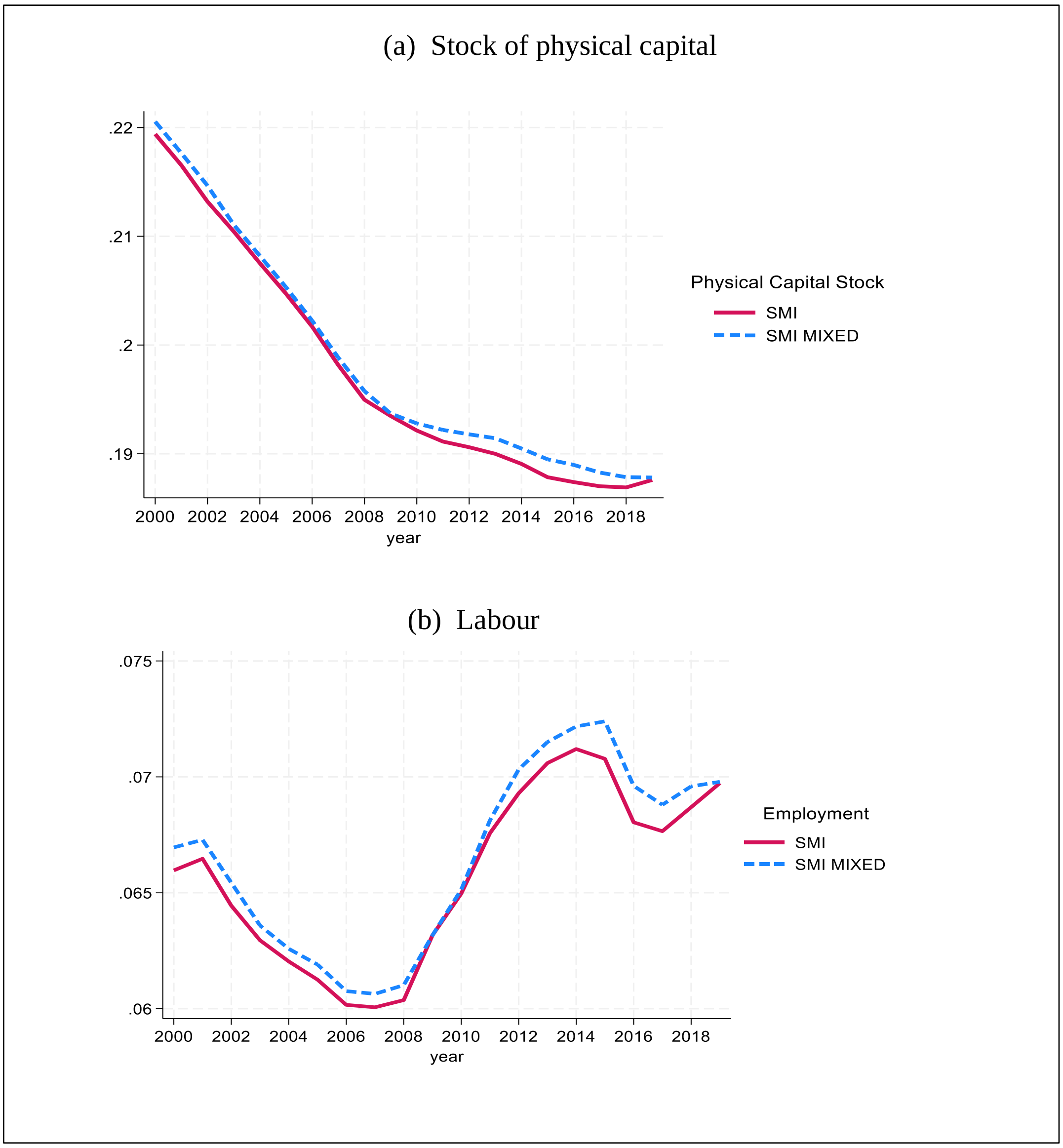
Figure 1.3 displays the evolution of the SMIs (and the corresponding mixed SMIs) for each variable considered, from 2000 to 2019. As indicated above, SMIs represent the percentage of the population that would need to migrate to other European regions for the distributions of population and production factors to equalise, and a spatial match to be achieved. When the SMI shrinks, the two distributions become more alike, whereas an increase in the SMI would indicate a widening gap between them. From Figure 3 is clear

[19] In this paper, we refer to the "distribution of population" from a regional perspective, i.e., considering how densely populated each region (NUTS2) of the European Union is. See Martin (2004).

that the SMI for the case of the stock of physical capital (Figure 1.3a) takes values greater than the SMI for labour (Figure 1.3b). This indicates that the regional distribution of the stock of physical capital in Europe with respect to the distribution of the European regional population is more unequal that the distributions of population and labour. Thus, the mismatch between the availability of regional population and the availability of physical capital for the European regions is greater than the mismatch between European regional population and European regional labour.

Also, to provide further support for the spatial mismatch trend analysis, and to detect some of the driving forces underlying these imbalances, each subfigure of Figure 1.4 illustrates the changes corresponding to the SMI change (dotted lines), as well as the changes in its two components: the production factor change (solid line), corresponding to Equation (3), and the population change (dashed line), corresponding to Equation (4).

Figure 1.3 Spatial mismatch index (SMI) and mixed mismatch index (SMIMIXED), European regions (NUTS-2), 2000-2019



Source: own elaboration

Figure 1.4 Changes for SMI, production factors and population, European regions (NUTS-2), 2000-2019

Source: own elaboration

Figure 1.3a represents the evolution of both the SMI (solid line) and its mixed variant (dashed line) corresponding to the stock of physical capital (SMI_K). It shows a steady decline over the entire sample period (except for years 2018 and 2019), from 21.94% to 18.80%, indicating a general convergence pattern between the distributions of this productive factor and the European regional population. This might indicate that the distribution of physical capital stock and population across European regions are following the same spatial location pattern. Nevertheless, for the two last years (2018 and 2019), the SMI indicates divergence (later corroborated in Figure 1.4a, where total change is positive).

One might question which force dominates the convergence/divergence process—either the production factor (in this case, physical capital stock) or the population. The answer is provided by inspecting the components of the SMI change in Figure 4, whose first subfigure (1.4a) reveals a general pattern: before the financial crisis, the two forces are generating convergence (physical capital stock change and population change), but after the crisis, the only driver of convergence is population change. The population change dominated the convergence process of the SMI_k until the year 2018, when the physical capital stock change was generating divergence.

The other core factor of production we analyse is labour[20]. Figure 3b reports the graphical evolution of the spatial mismatch indexes corresponding to labour (solid and dashed lines for SMI_L and $SMIMIXED_L$, respectively).

Figure 1.3b corroborates the patterns described above, revealing the presence of four subperiods, which are partly related to the business cycle—although several European countries desynchronies after the 2007/08 crisis (Degiannakis et al., 2014).[21] During the first of these subperiods (2000-2006), the SMI_L declines (see the solid line in Figure 3b) and, therefore, labour and population converge—the gap between the two distributions shrinks.

Figure 1.4b shows that both population and labour underlie this trend, since their corresponding changes are mostly negative throughout this subperiod.

In contrast, during the period after the onset of the economic and financial crisis (2007-2013), Figure 1.3b shows divergence between the distribution of employment and

[20] The relationship between labour and the distribution of population is also a central issue in regional economics which has been explored by the literature through approaches such as the "jobs follow people or people follow jobs" dilemma (Carlino and Mills, 1987; Hoogstra et al., 2017) .In this case we propose a new approach that is inspired in the spatial mismatch hypothesis, as discussed in previous sections (see Martin, 2001, 2004; Sahin et al., 2014, among others).

[21] This issue will be explicitly dealt with in the next subsection.

that of the population, with the sharp positive shifts in employment (see the solid line in Figure 1.4b) mainly accounting for this divergent pattern. With the easing of the crisis (2014-2016), as shown in Figure 1.3b, SMI_L started to decline again, with the results reported in Figure 1.4b indicating that population shifts explained this short convergent process, whereas the opposite occurs between 2017 and 2019. From the previous results, it is important to highlight that while the population change is showing negative values (inducing divergence), labour change is the one that generates the changes from convergence to divergence.

In general, we find an almost cyclical behaviour of the spatial mismatch index for labour which, overall, increased slightly over the entire period (from 6.60% to 6.97%). This suggests that, although unemployment differentials across EU regions eased for short periods of time (due to shifts in either population or labour), we can conclude that European job seekers did not move on a large scale to fill vacancies in other regions (either in their home country or in another European country) a finding that corroborates previous literature (e.g., Puga, 2002), but from a new perspective[22].

1.4.2.- Country analysis

To provide a more detailed illustration of the results for the spatial mismatch index, we report individual results for each country, for the two variables considered, and for selected sample years (2000, 2010, 2019). These results are shown in Table 1.2, in which the bottom line corresponds to each of the SMI indices reported in Figure 1.3. Each of the spatial mismatch indexes represents the percentage of population of Europe that must move to other regions for the distribution of European regional population and the regional production factor across European regions to be identical. The other rows in Table 1.2 show the relative contribution of each European country to the European SMI (i.e., the result by country corresponding to Equation (1)). Each of the previous contributions are calculated in absolute values. Nevertheless, previous to the computation of the absolute value, each country's contribution can be either positive (inflow) or

[22] If an external shock (e.g., a financial crisis) modifies the labour distribution, resulting in a misalignment between the distribution of vacancies and unemployment, job-seekers might respond by moving to regions where vacancies exist. In such a case, population shifts should offset the mismatch, leading population and labour distributions to convergence and, therefore, SMIL would show a downward trend. In contrast, the two distributions will diverge if job-seekers are not mobile. As a consequence, the resulting unemployment differentials would be exacerbated, and might become persistent (such as in the case of the EU), and reach magnitudes almost as large within countries as among regions (Elhorst, 2003).

negative (outflow)[23]. A positive (negative) contribution would indicate that the country's population is lower (higher) than the corresponding level according to its production factor endowment.

In the case of capital stock, the sum comes to 21.94%, 19.21% and 18.76%, for 2000, 2010 and 2019, respectively, but the contributions are quite heterogeneous across countries, both in magnitude and sign.

The largest and richest economies in the EU contribute greatly and positively to the mismatch, with Germany, France, Italy and the UK having the highest values among those countries with *inflows (*i.e., countries that should receive migrants for the distributions of population and capital stock in the European regions to equalize). In all these countries, except for the UK, the tendency is to converge (i.e., the mismatch shrinks over time). At the other extreme, for Poland and Romania, contributions to the EU spatial mismatch corresponding to capital stock are negative (outflow) and their magnitude is high.

With respect to labour, Table 1.2 shows that the SMI comes to 6.60%, 6.50% and 6.97%, for the years 2000, 2010 and 2019, respectively. The analysis of the contributions is quite heterogeneous across countries, both in magnitude and sign. The results indicate that each country's contribution in terms of inflow or outflow are not homogeneous. Hence, across the different dimensions explored (SMIK and SMIL), some countries show opposite trends for labour (e.g., France and Italy, the ones which show the greatest outflows in the case of the SMIL). On the other hand, for the case of the inflows, the greatest values are obtained for the same countries that in the case of the capital stock: Germany and United Kingdom.

1.4.3.- Region-specific analyses by grouping in Cohesion and non-Cohesion countries.

Exploring the results by country provides insightful partial conclusions. However, this approach might overlook the existence of significant heterogeneity among European regions. To address this, Tables 1.3 and 1.4 rank regions according to their relative

[23] These names were assigned because, from the perspective of the population, the positive (negative) value would imply an inflow (outflow) of population to compensate the mismatch.

contributions (inflow or outflow) to the European spatial mismatch. These contributions are considered in each of their dimensions (capital stock and labour)[24]. Table 1.3 shows when the contributions are negative (outflow), most regions belong to Eastern European countries. On the other hand, the inflows in Table 1.4 are more geographically dispersed, located in both Southern and Northern European countries.

Based on the intuition provided in Tables 1.2, 1.3 (outflows), and 1.4 (inflows), several factors might explain these results. We explore some of these factors, following Quah (1996), who proposes an analysis of per capita income convergence by estimating densities via kernel smoothing for each region and considering different conditioning schemes.

In our case, we search for different patterns in the densities estimated for the European regional inflows and outflows. These are grouped by Cohesion and non-Cohesion countries, as suggested by (Jagódka and Snarska, 2023). By doing this, we might be able to see whether the mismatches between population and factor endowments differ between these two groups of countries. Our analysis compares the inflows and outflows for regions in Cohesion countries vis-à-vis those in non-Cohesion countries. The results are reported in Figure 1.5, which reveal several patterns[25].

[24] Although reporting individual results is difficult due to the high number of regions (close to 300), we still find it informative. Therefore, we report at least the top 30 regions according to their negative (outflows) or positive contributions (inflows).

[25] These figures contain densities estimated using kernel smoothing methods for spatial mismatch indices, for all production factors and GDP, for cohesion and non-cohesion countries. Bandwidths were selected using plug-in methods (Li and Racine, 2007), and the Epanechnikov kernel was selected. The vertical lines in each subfigure correspond to the average.

Table 1.2 Spatial Mismatch Indexes, European Union, country level, selected years

Country	Capital stock (K)						Employment (L)					
	2000		2010		2019		2000		2010		2019	
Austria (AT)	0.55	Inflow	0.50	Inflow	0.49	Inflow	0.09	Inflow	0.11	Inflow	0.11	Inflow
Belgium (BE)	0.38	Inflow	0.40	Inflow	0.46	Inflow	0.20	Outflow	0.17	Outflow	0.17	Outflow
Bulgaria (BG)	0.76	Outflow	0.63	Outflow	0.54	Outflow	0.09	Outflow	0.10	Inflow	0.09	Inflow
Croatia (HR)	0.34	Outflow	0.29	Outflow	0.25	Outflow	0.08	Outflow	0.05	Outflow	0.05	Outflow
Cyprus (CY)	0.03	Outflow	0.03	Outflow	0.03	Outflow	0.00	Inflow	0.01	Inflow	0.00	Inflow
Czech Republic (CZ)	0.53	Outflow	0.49	Outflow	0.47	Outflow	0.10	Inflow	0.11	Inflow	0.10	Inflow
Denmark (DK)	0.29	Inflow	0.32	Inflow	0.33	Inflow	0.10	Inflow	0.09	Inflow	0.08	Inflow
Estonia (EE)	0.11	Outflow	0.07	Outflow	0.06	Outflow	0.01	Outflow	0.01	Outflow	0.01	Inflow
Finland (FI)	0.24	Inflow	0.26	Inflow	0.27	Inflow	0.06	Inflow	0.04	Inflow	0.05	Inflow
France (FR)	1.71	Inflow	1.64	Inflow	1.71	Inflow	0.68	Outflow	0.75	Outflow	0.92	Outflow
Germany (DE)	3.16	Inflow	2.49	Inflow	2.44	Inflow	1.05	Inflow	1.19	Inflow	1.36	Inflow
Greece (EL)	0.25	Outflow	0.26	Outflow	0.40	Outflow	0.11	Outflow	0.08	Outflow	0.15	Outflow
Hungary (HU)	0.79	Outflow	0.66	Outflow	0.58	Outflow	0.31	Outflow	0.33	Outflow	0.29	Inflow
Ireland (IE)	0.07	Inflow	0.15	Inflow	0.35	Inflow	0.00	Inflow	0.03	Outflow	0.03	Outflow
Italy (IT)	2.21	Inflow	1.76	Inflow	1.39	Inflow	0.74	Outflow	0.71	Outflow	0.74	Outflow
Latvia (LV)	0.20	Outflow	0.14	Outflow	0.11	Outflow	0.03	Outflow	0.02	Outflow	0.00	Outflow

Lithuania (LT)	0.30	Outflow	0.23	Outflow	0.17	Outflow	0.03	Outflow	0.03	Outflow	0.02	Inflow
Luxembourg (LU)	0.05	Inflow	0.06	Inflow	0.08	Inflow	0.02	Inflow	0.03	Inflow	0.04	Inflow
Malta (MT)	0.02	Outflow	0.02	Outflow	0.02	Outflow	0.01	Outflow	0.00	Outflow	0.00	Inflow
The Netherlands (NL)	0.57	Inflow	0.62	Inflow	0.60	Inflow	0.28	Inflow	0.30	Inflow	0.30	Inflow
Poland (PL)	3.22	Outflow	2.97	Outflow	2.64	Outflow	0.55	Outflow	0.48	Outflow	0.39	Outflow
Portugal (PT)	0.39	Outflow	0.36	Outflow	0.38	Outflow	0.12	Inflow	0.05	Inflow	0.05	Inflow
Romania (RO)	2.01	Outflow	1.59	Outflow	1.37	Outflow	0.28	Inflow	0.14	Outflow	0.22	Outflow
Slovakia (SK)	0.40	Outflow	0.34	Outflow	0.32	Outflow	0.13	Outflow	0.12	Outflow	0.10	Outflow
Slovenia (SI)	0.11	Outflow	0.07	Outflow	0.07	Outflow	0.01	Inflow	0.02	Inflow	0.03	Inflow
Spain (ES)	0.85	Outflow	0.73	Outflow	0.93	Outflow	0.55	Outflow	0.56	Outflow	0.58	Outflow
Sweden (SE)	0.79	Inflow	0.68	Inflow	0.72	Inflow	0.09	Inflow	0.08	Inflow	0.08	Inflow
United Kingdom (UK)	1.59	Inflow	1.47	Inflow	1.59	Inflow	0.87	Inflow	0.86	Inflow	1.02	Inflow
EU	**21.94**		**19.21**		**18.76**		**6.60**		**6.50**		**6.97**	

Source: own elaboration

Table 1.3 Regional Mismatch in the European Union, top regions according to population flows

Capital stock, 2000		Capital stock, 2019		Employment, 2000		Employment, 2019	
Region code, (NUTS-2)	**Region name**	**Region code, (NUTS-2)**	**Region name**	**Region code, (NUTS-2)**	**Region name**	**Region code, (NUTS-2)**	**Region name**
PL22	Slaskie	ES61	Andalucía	ES61	Andalucía	ES61	Andalucía
RO21	Nord Est	PL22	Slaskie	ITG1	Sicilia	ITG1	Sicilia
RO31	Sud Muntenia	RO21	Nord-Est	ITF3	Campania	ITF3	Campania
ES61	Andalucía	PL21	Malopolskie	ITF4	Puglia	ITF4	Puglia
PL21	Malopolskie	PL41	Wielkopolskie	PL22	Slaskie	UKN0	Northern Ireland (UK)
RO22	Sud Est	RO31	Sud - Muntenia	UKN0	Northern Ireland (UK)	FRE1	Nord Pas de Calais
PL41	Wielkopolskie	RO11	Nord-Vest	PL51	Dolnoslaskie	ES52	Comunidad Valenciana
RO11	Nord-Vest	ITF3	Campania	FRE1	Nord Pas de Calais	UKI5	Outer London East and Northeast
PL51	Dolnoslaskie	RO22	Sud-Est	ITF6	Calabria	FRJ1	Languedoc Roussillon
RO12	Centru	PL51	Dolnoslaskie	PL63	Pomorskie	FRF3	Lorraine
LT02	Vidurio ir vakaru Lietuvos regionas	ITG1	Sicilia	FRL0	Provence Alpes Côte d'Azur	ITF6	Calabria
HR04	Kontinentalna Hrvatska	PL71	Lódzkie	ES11	Galicia	FRL0	Provence Alpes Côte d'Azur
PL71	Lódzkie	PT11	Norte	HU32	Észak Alföld	PL22	Slaskie
RO41	Sud-Vest Oltenia	HR04	Kontinentalna Hrvatska	HR04	Kontinentalna Hrvatska	PL81	Lubelskie
LV00	Latvija	RO12	Centru	HU31	Észak Magyarország	FRE2	Picardie
PL81	Lubelskie	PL81	Lubelskie	FRJ1	Languedoc-Roussillon	FRK2	Rhône Alpes

PL92	Mazowiecki regionalny	PL92	Mazowiecki regionalny	SK04	Východné Slovensko	ES42	Castilla la Mancha
PT11	Norte	RO41	Sud-Vest Oltenia	PL82	Podkarpackie	RO31	Sud Muntenia
PL82	Podkarpackie	PL82	Podkarpackie	BE32	Prov. Hainaut	FRB0	Centre Val de Loire
RO42	Vest	PL61	Kujawsko Pomorskie	PL62	Warminsko Mazurskie	FRD2	Haute Normandie
PL61	Kujawsko Pomorskie	PL63	Pomorskie	ITG2	Sardegna	BE32	Hainaut
BG41	Yugozapaden	ES52	Comunidad Valenciana	UKL1	West Wales and The Valleys	FRH0	Bretagne
PL63	Pomorskie	ITF4	Puglia	PL91	Warszawski stoleczny	SK04	Východné Slovensko
BG42	Yuzhen tsentralen	BG41	Yugozapaden	FRF3	Lorraine	PL71	Lódzkie
PL42	Zachodniopomorskie	RO42	Vest	SK02	Západné Slovensko	ES11	Galicia
SK02	Západné Slovensko	LT02	Vidurio ir vakaru Lietuvos regionas	HU12	Pest	EL52	Kentriki Makedonia
HU32	Észak Alföld	PL42	Zachodniopomorskie	FRE2	Picardie	ITG2	Sardegna
PL91	Warszawski stoleczny	BG42	Yuzhen tsentralen	UKI5	Outer London East and Northeast	FRI1	Aquitaine
PL62	Warminsko Mazurskie	EL30	Attiki	ES41	Castilla y León	ITC1	Piemonte
ITG1	Sicilia	SK04	Východné Slovensko	PL52	Opolskie	HU32	Észak Alföld

Source: own elaboration

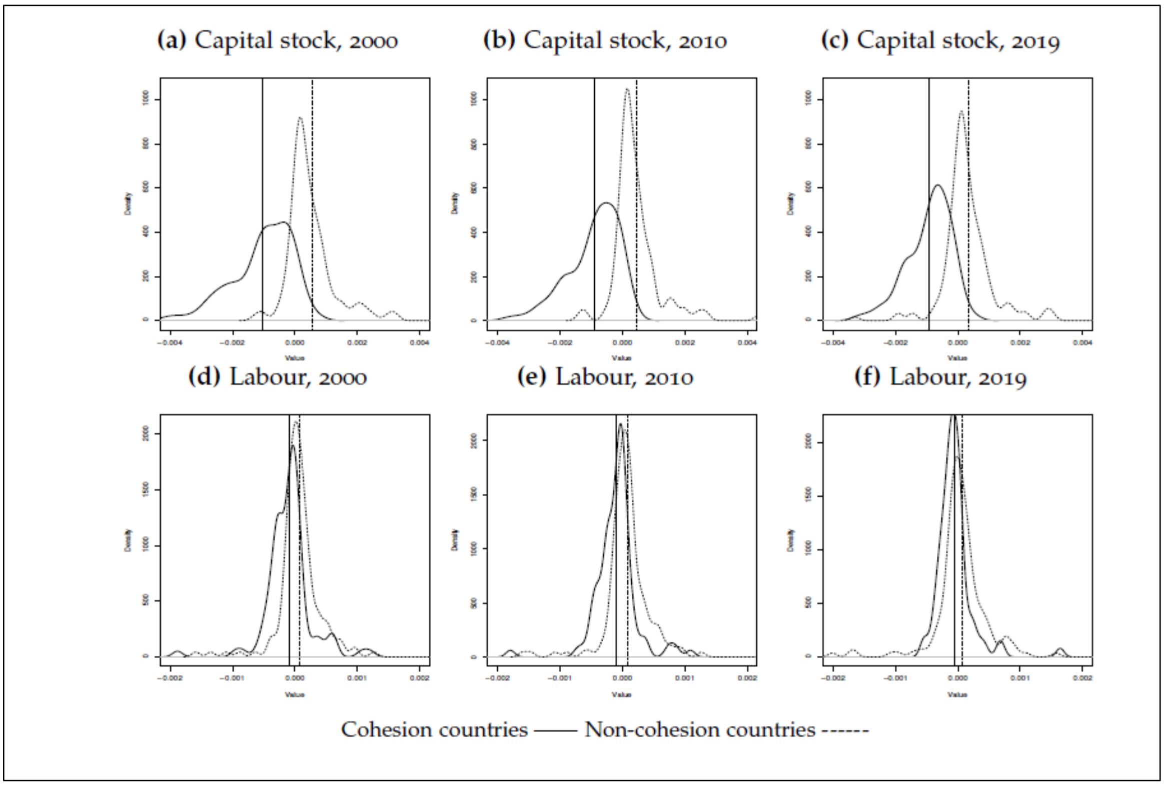
Table 1.4 Regional Mismatch in the European Union, top regions according to population inflows

Capital stock, 2000		Capital stock, 2019		Employment, 2000		Employment, 2019	
Region code, (NUTS-2	**Region name**	**Region code, (NUTS-2)**	**Region name**	**Region code, (NUTS-2)**	**Region name**	**Region code, (NUTS-2)**	**Region name**
FR10	Île de France	FR10	Île de France	UKI3	Inner London West	UKI3	Inner London West
DE21	Oberbayern	DE21	Oberbayern	FR10	Île de France	HU11	Budapest
ITC4	Lombardia	UKI3	Inner London West	DE21	Oberbayern	DE21	Oberbayern
SE11	Stockholm	SE11	Stockholm	RO21	Nord Est	FR10	Île de France
DE11	Stuttgart	DE11	Stuttgart	HU11	Budapest	DE11	Stuttgart
UKI3	Inner London West	ITC4	Lombardia	DE11	Stuttgart	DE71	Darmstadt
ITH5	Emilia-Romagna	IE05	Southern	DE71	Darmstadt	NL32	Noord-Holland
DE71	Darmstadt	DE60	Hamburg	NL32	Noord Holland	DE60	Hamburg
DE60	Hamburg	DE71	Darmstadt	DE60	Hamburg	DEA2	Köln
AT13	Wien	DK01	Hovedstaden	ITC4	Lombardia	DEA1	Düsseldorf
ITC1	Piemonte	UKJ1	Berkshire, Buckingham shire and Oxfordshire	DEA1	Düsseldorf	ES30	Comunidad de Madrid
ITH3	Veneto	AT13	Wien	RO41	Sud Vest Oltenia	UKJ1	Berkshire, Buckingham shire and Oxfordshire
UKJ1	Berkshire, Buckingham shire and Oxfordshire	FI1B	Helsinki Uusimaa	ES51	Cataluña	DE30	Berlin
ITI4	Lazio	NL32	Noord Holland	CZ01	Praha	BG41	Yugozapaden
FRK2	Rhône Alpes	NL33	Zuid Holland	SE11	Stockholm	CZ01	Praha
DK01	Hovedstaden	SE23	Västsverige	ES30	Comunidad de Madrid	DE12	Karlsruhe
SE23	Västsverige	FRK2	Rhône Alpes	DE12	Karlsruhe	NL41	Noord Brabant
NL32	Noord Holland	BE21	Antwerpen	UKJ1	Berkshire, Buckingham shire and Oxfordshire	SE11	Stockholm

FI1B	Helsinki Uusimaa	ITH5	Emilia Romagna	DK01	Hovedstaden	DK01	Hovedstaden
NL33	Zuid-Holland	ITC1	Piemonte	NL33	Zuid Holland	DE25	Mittelfranken
DEA2	Köln	DE12	Karlsruhe	BE10	Région de Bruxelles Capitale	NL33	Zuid Holland
DE12	Karlsruhe	DE25	Mittelfranken	DEA2	Köln	DE94	Weser Ems
DE25	Mittelfranken	UKM5	Northeastern Scotland	PT17	Área Metropolitana de Lisboa	DE13	Freiburg
UKI4	Inner London East	BE10	Région de Bruxelles Capitale	NL41	Noord Brabant	RO32	Bucuresti Ilfov
DE27	Schwaben	SE12	Östra Mellansverige	AT13	Wien	UKI4	Inner London East
SE12	Östra Mellansverige	DE14	Tübingen	DE25	Mittelfranken	ITC4	Lombardia
DE14	Tübingen	IE06	Eastern and Midland	NL31	Utrecht	DE14	Tübingen
DE30	Warszawski stoleczny	NL41	Noord-Brabant	DE30	Berlin	SK01	Bratislavský kraj
BE10	Warminsko Mazurskie	DE27	Schwaben	RO31	Sud Muntenia	LU00	Luxembourg
UKK1	Sicilia	ITH3	Veneto	ITH5	Emilia Romagna	AT13	Wien

Source: own elaboration

Figure 1.5 Densities corresponding to spatial mismatch indices, cohesion, and non-cohesion countries[a].



[a]These figures contain densities estimated using kernel smoothing methods for spatial mismatch indices, for all production factors and GDP, for cohesion and non-cohesion countries. Bandwidths were selected using plug-in methods (Li and Racine, 2007), and the Epanechnikov kernel was selected. The vertical lines in each subfigure correspond to the average.

Own Elaboration

The first point to note is that, regardless of the spatial mismatch dimension (be it capital stock or labour), the results differ significantly between Cohesion and non-Cohesion countries. This is evident in the location of the probability mass for each density. In the case of Cohesion countries (represented by solid lines), the mass is primarily below zero. However, for non-Cohesion countries (represented by dashed lines), it shifts considerably more to the right (see Figures 1.5a, 1.5b and 1.5c). An analysis of the averages reveals that non-Cohesion countries have positive averages, while in the case of Cohesion countries the sign is opposite. Consequently, a general pattern emerges inflows are more frequent in non-Cohesion countries, implying that their populations are lower than the corresponding to their levels of physical capital stock and labour, whereas the pattern is the opposite for Cohesion countries.

The second is that densities corresponding to physical capital stock for non-Cohesion countries have lower dispersion than the corresponding to Cohesion countries. This implies the existence of more heterogeneity within the latter than the former, with several regions making much higher contributions—either positive or negative—to spatial mismatches in the EU.

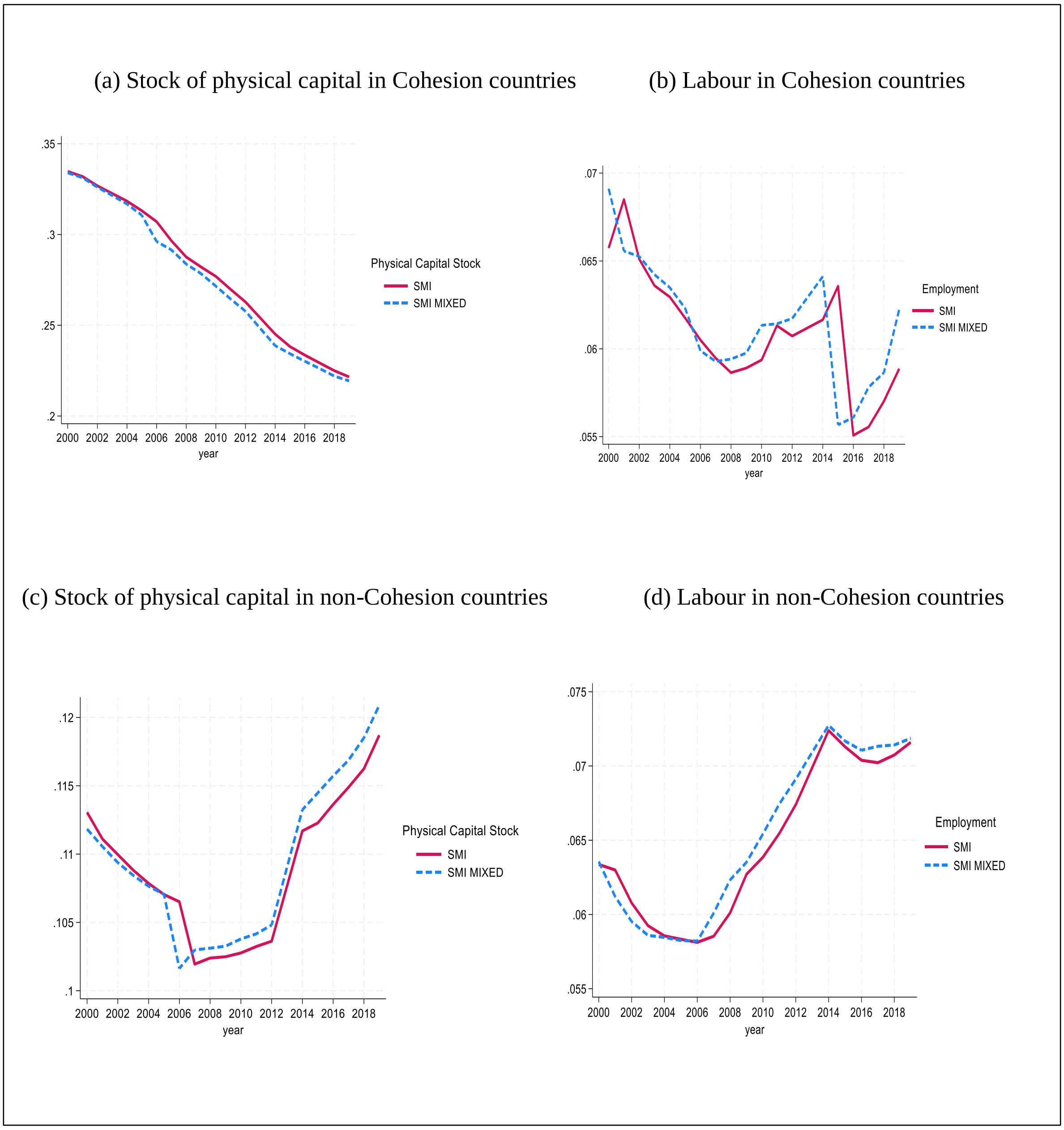
As a supplement to the previously conducted analysis, it appears beneficial to calculate the SMI for both groups of countries. This is represented graphically in Figure 6. The upper panel (Cohesion countries) show much higher values for the SMI of the physical capital stock (values above 20 percent) compared to those for in the lower panel, for non-Cohesion countries (with values below 12 percent). Therefore, in the case of Cohesion countries, a larger percentage of the population would need to be relocated to equalize the distributions of population and physical capital stock. This implies that the availability of physical capital stock for regional populations in these countries is not on par with that in non-Cohesion countries.

Figure 1.6 illustrates decreasing trends in the SMIs of Cohesion countries, indicating convergence, while non-Cohesion countries exhibit increasing trends, suggesting divergence. The trend in the physical capital stock of Cohesion countries decreases across all considered periods, indicating convergence in terms of population, while the SMI of non-Cohesion countries exhibits a cyclical pattern. The SMI corresponding to labour in non-Cohesion countries also shows a cyclical pattern, although the trend over the period is decreasing. In Cohesion countries, the pattern is similar to that depicted in Figure 1.3. In summary, while the SMI (for both capital stock and labour) in Cohesion countries tends to converge over the considered period, in non-Cohesion countries, population and production factors tend to diverge.

Our results point to a duality in the distributions of the SMIs, indicating the possible existence of two clusters of countries. This suggests that the spatial mismatch between the factors of production and the population could be associated with the categorization of Cohesion versus non-Cohesion countries. We could hypothesize that the reason for the existence of two types of European countries is rooted in the location of regional production factors relative to the regional population, among other factors, although this should be subject to formal testing.

If this is indeed the case, the spatial mismatch of labour and physical capital stock relative to population in European regions should be considered when formulating corrective strategies for internal imbalances within these regions. As part of an exploratory study, we will analyse in the following subsection the impact that an increase (or decrease) in these mismatches has on inequality and economic growth in Europe.

Figure 1.6 Regional Spatial mismatch indices for Cohesion and non-Cohesion countries, 2009-2019.



Source: own elaboration

1.4.4.- Evaluating the interactions between regional growth, equity and spatial mismatch of regional productive factors

In the previous sections, our exploratory analysis has shown that the regional location of production factors (labour and capital) can lead to either convergence or divergence between them and the population. This analysis has several implications, as public policies could affect the mobility of capital and labour, thereby affecting growth and regional inequality in Europe. These ideas have been previously explored by Baldwin and Martin (2004), who showed that capital mobility is crucial for the link between growth and agglomeration and points out that an absence of capital mobility could lead to catastrophic spatial agglomeration (see also Castells-Quintana and Royuela, 2014).

The relationship between economic growth and inequality has given rise to conflicting interpretations (Aghion et al., 1999), due to the contradictory findings on the impact of inequality on economic growth in the literature (Royuela et al., 2019; Panzera and Postiglione, 2022). Since the location of labour and capital could be crucial in determining regional economic growth and inequalities, we extend this analysis by assessing the impact of the spatial disconnections between production factors (employment and physical capital stock) and population on regional growth and equity. The vector-autoregressive analysis carried out in this subsection proposes several hypotheses. These concern the relationships between economic growth, inequality growth and the two spatial mismatch indices (SMIs) with respect to the production factors considered.

To quantify inequality, we consider Theil's *T* index, which tracks the evolution of the concentration of GDP per capita in European regions over the period under consideration[26]. According to our findings, depicted in Figure 1.7, the Theil index exhibits a declining trend from 2000 to 2009, indicating a decrease in inequality in the distribution of GDP per capita. It then increases during the crisis period (between 2010 and 2013)

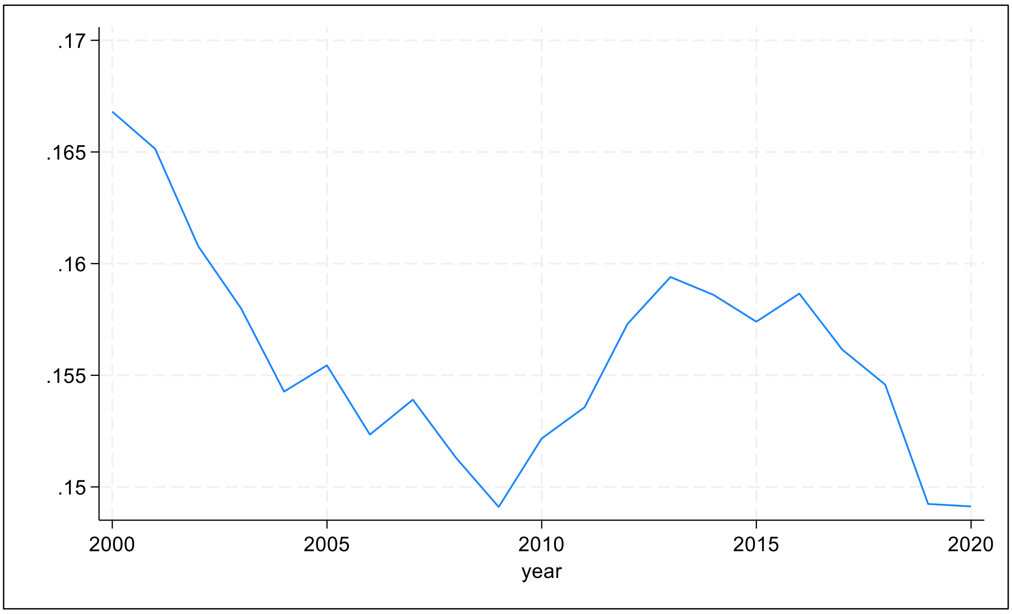
[26] In this case, the Theil is defined as follows:

$$T = \frac{1}{N}\sum_{i=1}^{N} \frac{GDPpc_i}{GDPpc} \times ln\left(\frac{GDPpc_i}{GDPpc}\right)$$

where $GDPpc_i$ is value of the GDP per capita for European region i, GDPpc is the average of GDP per capita for European regions, and N is the total number of European regions.

before resuming a decreasing trend from 2014 to 2020. In general, our analysis concludes that the level of inequality decreased over the period analysed.

Figure 1.7 Theil inequality index for European regional GDP per capita (NUTS-2), 2000-2020



Source: Own elaboration

Table 1.5 shows the correlation coefficients between European GDP growth (g_{GDP}), European inequality growth (that is, the growth of the Theil index, denoted as g_{Theil}), and the two spatial mismatch indices (SMIs) considered (related to labour, SMI_L, and physical capital, SMI_k). As shown in Table 1.5, g_{GDP} is negatively correlated with both g_{Theil} and SMI_L. However, it is positively correlated with SMI_K. In contrast, g_{Theil} is negatively correlated with SMI_L and positively correlated with SMI_K. Finally, the correlation between SMI_L and SMI_K is negative.

Table 1.5 Correlation coefficients among spatial mismatch indexes, GDP growth and inequality growth, 2001-2019

	SMI_K	SMI_L	g_{GDP}	g_{Theil}
SMI_K	1.00	- 0.60	0.25	- 0.42
SMI_L		1.00	- 0.25	0.3402
g_{GDP}			1.00	- 0.13
g_{Theil}				1.00

Source: Own elaboration

With regard to the above correlations, we argue that regional economic growth, regional inequality growth and the location of the regional population with respect to the location of the factors of production (labour and physical capital) operate simultaneously within a regional economic system. We assume that each of these four variables can be affected by temporary changes in the other variables, i.e. a shock to one variable affects the behaviour of the others. It is therefore interesting to analyse how these temporary changes affect economic growth, inequality growth and the two spatial mismatch indices, for which we explicitly evaluate the interactions between the four variables. For this purpose, we will consider a vector autoregression analysis (Sims, 1980; Stock and Watson, 2001). The four variables in the vector autoregressive (VAR) model are considered endogenous (i.e. g_{GDP}, g_{Theil}, SMI_L and SMI_K). The VAR model is assumed to have the form:

$$\Upsilon_t = \alpha_0 + \alpha_1 \Upsilon_{t-1} + \alpha_2 \Upsilon_{t-2} + \cdots + \alpha_p \Upsilon_{t-p} + u_t \qquad (9)$$

where Υ_t represents a 4 × 1 vector of endogenous variables, for t = 2000, 2001,…,2020; α_0 is a vector of intercept terms, and α_i denotes a vector of coefficients, i=1…,p ; u_t corresponds to the error term, with $E(u_t) = 0$ and $E(u_t u_t') = \Omega$, being Ω a 4 × 4 symmetric variance-covariance matrix.

Having estimated the specified model, we used four different model selection criteria to select the lag order.[27] As a result, we consider a maximum of two lags (p=2) for the specified VAR model. Additionally, we checked the stability of the estimated

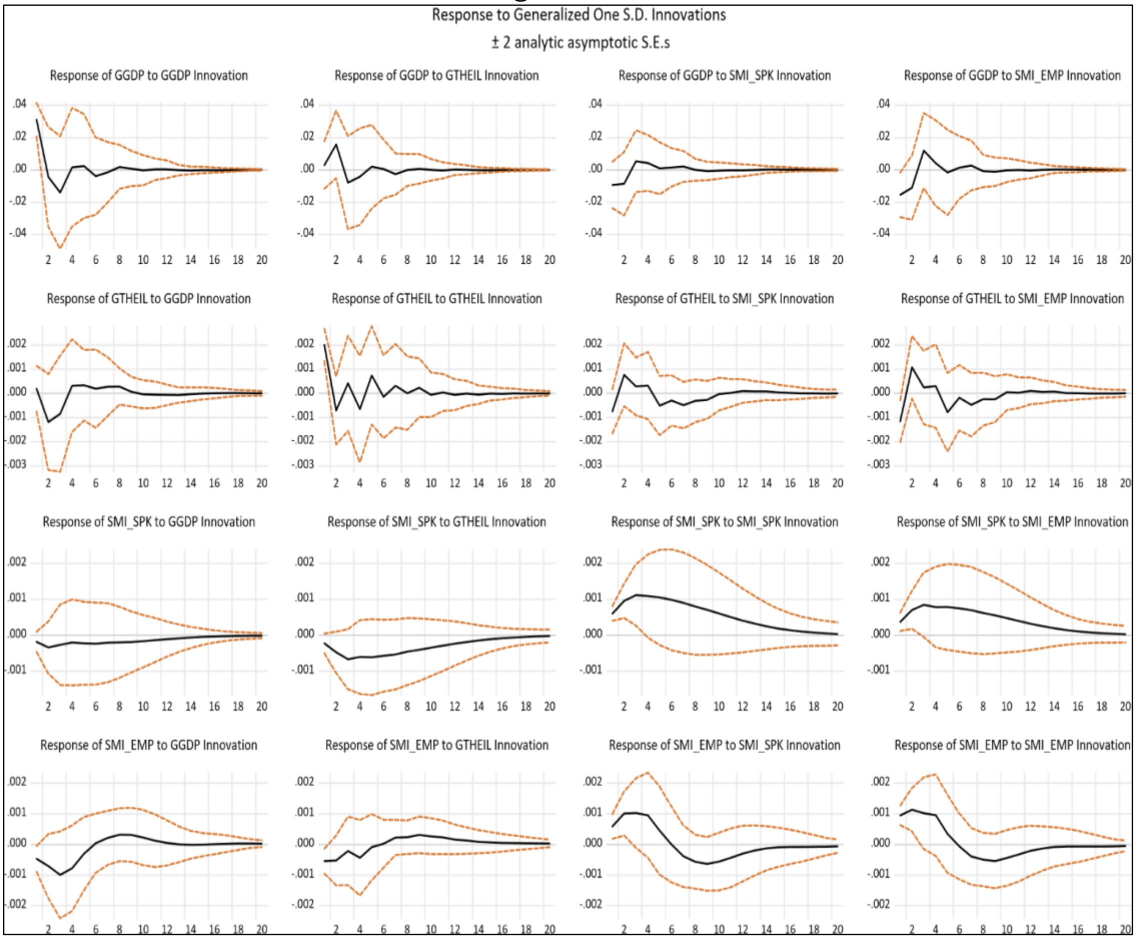
[27] Optimal lag determined by standard statistical information criteria: Final Prediction Error, Akaike Information Criterion, Schwarz Information Criterion and Hannan-Quinn Information Criterion. According to these criteria, the second-order VAR was preferred.

VAR. Since all eigenvalues lie within the unit circle (i.e. all eigenvalues have a modulus less than 1), our VAR satisfies the stability condition (Lütkepohl, 2005).

Given the stability of the VAR, we consider impulse response functions (IRFs) to estimate the short-run dynamic relationships of the endogenous variables following an exogenous shock[28]. Figure 1.8 shows the transmission mechanism for the four endogenous variables (responses in rows for each of the variables) of exogenous shocks from each variable (in columns) to the system. The response function (solid line in each graph in Figure 1.8) and the corresponding confidence interval provide evidence of the estimated effects for the 20 years considered in the simulation. The horizontal axis represents the number of periods considered (20). The longitudinal axis is the response of the shocks to each of the endogenous variables in economic growth (first row of graphs), in inequality growth (second row of graphs), in SMI_L (third row) and in SMI_K (fourth row).

[28] The econometric model described is used to empirically analyse the impact of exogenous changes in each endogenous variable on the rest of the endogenous variables in the model. More specifically, the impulse response functions are estimated to capture the effect of a one-standard-deviation shock to one variable on the current and future values of the rest of the variables. In our empirical application, we use generalised impulse response functions (GIRFs) proposed by Pesaran and Shin (1998), which are not sensitive to the order of the variables.

Figure 1.8 Graphs by generalised impulse responses of European economic growth (GGDP), European economic inequality growth. (GTHEIL), SMLL and SMIk to shock in the endogenous variables.



Source: own elaboration

According to Figure 1.8, our VAR model is very stable, as the impulse responses disappear after a few years. The convergence of the effects to zero is a very important result, as it provides empirical evidence of the stability of the system of equations (Lütkepohl, 2005)[29]. As a general conclusion, the stability of the system of equations and the robustness of the results obtained from the impulse responses are remarkable.

The statistical implementation of the VAR model allows us to estimate the links between the endogenous variables, and some implications can be drawn from the results of our empirical exercise. What our results emphasize is that an exogenous positive shock

[29] As an additional sensitivity analysis, we estimate a Cholesky decomposition, which is sensitive to the order of the variables. We use different orders of the variables in the vector t, given that the impulse responses are very similar.

to one endogenous variable has different effects on the rest of the endogenous variables before settling at zero in the long run.

The graphs in the first column of Figure 1.8 show that a shock to European economic growth has a positive and significant effect on economic growth, while it has a negative and significant effect on SMI_L. According to the IRFs, initially, an increase in the European economic growth has a positive effect on economic growth, as it is statistically significant for only one year after the economic growth shock takes place. In contrast, the effect of an increase in the European economic growth has a negative effect on the spatial mismatch index of employment. This negative effect remains statistically significant until one year after the economic growth shock.

Similarly, the second column of Figure 1.8 shows that a shock in inequality growth has a positive and significant effect on inequality growth, while it has a significant negative effect on (SMI_L). Both effects remain statistically significant until one year after the inequality growth shock.

Consequently, the endogenous response to economic growth and inequality growth could be a reduction in the spatial mismatch between population and labour. This would be suggesting that the convergence between the spatial mismatch distribution of population and labour in Europe could be favoured by increasing European economic growth and/or European economic inequality. From Section 1.4.1, we consider that the change in the interregional distribution of labour forms the basis of these results, in accordance with Iammarino et al. (2019).

The graphs in the third column of Figure 1.8 show that a shock to the spatial mismatch between population and the stock of physical capital (SMI_K) generates a significant positive response for both SMI_K and SMI_L. These effects remain statistically significant until one year after the SMI_K shock. It is necessary to highlight that, according to the results obtained, a decrease in the SMI_K (that is, a negative shock) would imply a significant negative response for both SMI_k and SMI_L.

Finally, the sub-figures in the fourth column of figure 1.8 also show that a large imbalance between population and labour (SMI_L) has an initial and negative effect on economic growth during the following year[30]. On the other hand, the response of inequality growth to a positive (negative) shock to SMI_L is significant and negative (positive) before converging to zero. This result suggests that the location of the regional population with respect to labour could play a crucial role in reducing (increasing) regional inequalities. Another important result is that a positive (negative) shock to SMI_L would imply a significant positive (negative) effect for SMI_L one year after the shock, converging later to zero. Finally, a positive (negative) shock to SMI_L would imply a significant positive (negative) effect on SMI_K for a year after the shock before converging to zero. So, mismatches between population and labour generate mismatches between population and the stock of physical capital.

1.5.- Discussion

Based on the IRFs discussed in the previous paragraphs, our research does not indicate a direct trade-off between European economic growth and inequality growth. However, we have found evidence that the spatial mismatch between population and labour is the primary driver of the short-term dynamic relationships between the four endogenous variables.

The spatial mismatch between population and labour, which refers to the percentage of the population that needs to relocate for the labour distribution to match that of the European regional population, turns out to be a crucial variable. It has a key role in the trade-off between European economic growth and European economic inequality: increasing (reducing) the spatial mismatch between population and labour increases (reduces) economic growth, but also increases (reduces) economic inequality.

These increases in the spatial mismatch between population and labour can be obtained via changes in the relative spatial distribution of population (or labour) among the European regions. Additionally, increases in $\mathrm{SMI_K}$ may also result in an increase in the spatial mismatch between population and labour. The dynamic relationships between $\mathrm{SMI_L}$ and $\mathrm{SMI_K}$ also indicate this variable are strongly intertwined, as an increase in the

[30] This is equivalent to say that a negative shock on the SMIL would impact positively on both—GDP growth and inequality growth. This suggests that an increase in economic growth would require the distribution of population and labour across regions to be similar (i.e. a reduction in the imbalance would imply a positive effect on economic growth).

mismatch between the location of the (regional) population and the location of labour (SMI_L) has a positive effect on the mismatch between the (regional) location of population and the physical capital stock's location (SMI_K). Consequently, if the labour mismatch is reduced, it would have a negative effect on SMI_K, and vice versa. Therefore, there appears to be a significant positive interaction between the two types of SMIs, indicating a complementary relationship.

The general conclusion is that the geographical distribution of regional populations, in relation to regional production factors, can influence both overall economic growth and the increase in inequality across Europe. A decrease (increase) in inequality across Europe can be achieved by increasing (decreasing) both SMI_L and SMI_K. However, increasing (decreasing) SMI_L could result in a net decline (increase) in Europe's overall economic growth. This finding aligns with the study by Woo (2020), according to which a decrease in inequality achieved through resource redistribution might lead to a net decline in overall economic growth. Therefore, the mobility of the population (or labour mobility) that reduces spatial mismatches between population and labour could initially increase the growth of inequality. However, it could have a positive impact on economic growth.

Our findings imply that to address regional inequalities, the distribution of labour (and physical capital) should not be solely based on population criteria. Decreasing spatial mismatches among European regions could paradoxically lead to an increase in regional inequalities. However, this is the usual modus operandi in implementing regional policies, since resources tend to be distributed based on criteria related to the population variable[31]. Nevertheless, as previously discussed, these policies that favour the decrease of the growth of inequalities in European regions could potentially have negative effects on overall European economic growth.

Moreover, the significant positive interaction between the spatial mismatch for the European labour and the spatial mismatch for the European regional stock of physical capital would indicate the need to accompany regional employment policies with physical

[31] One approach to addressing regional imbalances could be to enact policies that attract and retain skilled labour in lagged regions. This could lead to a reduction in regional inequality growth (Asheim et al., 2011). Another strategy could involve policies that increase the concentration of physical capital stock in the regions of Cohesion countries, as this could help decrease regional economic inequality (Cieslik and Kaniewska, 2004).

capital endowment policies. These results echo those of Berg et al. (2018), who also found that economic inequality is associated with lower investment in both human and physical capital. Along similar lines, Barbero et al. (2024) have recently argued that, to reduce regional inequalities, investment should be allocated to the less developed regions of each European country.

The previous findings have significant policy implications, as they highlight that employment policies (such as allocating resources to develop people's knowledge and abilities, providing education and professional training) and investment in physical capital (ensuring fair and equitable access to opportunities) are determining factors in the fight against regional inequalities in Europe.

1.6.- Conclusions

The present study was designed to provide empirical evidence on the hypothesis that a spatial mismatch between the location of regional populations and the location of regional factors of production could affect the evolution of regional disparities[32]. This approach can help explain the prolonged loss of importance of certain regions in the regional economic system. By identifying the patterns of spatial mismatch, it is possible to identify obstacles to economic growth, and policymakers can implement targeted policies to promote economic development and job creation in underdeveloped regions. With these considerations in mind, our study aimed to investigate the existence of spatial mismatches between production factors and population in European regions, focusing on how these imbalances might affect regional inequality and economic growth. Indeed, the trade-off between the economic benefits of clustering production factors and the inequalities it may generate is particularly relevant in the European Union, where regional economic disparities exist[33].

[32] In general, analysing the spatial mismatch hypothesis could provide a valuable framework for understanding the causes of increasing regional inequalities in employment opportunities, regional economic growth, and productive resources, resulting in depopulation and limited prospects in less prosperous regions.

[33] When economic integration takes place, the nation's forming the agreement will naturally acquire the characteristics of large regions (Begg, 1995), with factor flows expected to contribute to the adjustment of regional and spatial imbalances or mismatches. Therefore, even in the absence of formal barriers to factor mobility, regional disparities may persist, resulting in different regional unemployment rates. This implies that de jure integration does not automatically ensure regional adjustment, with factor immobility thwarting the expected gains from integration.

Our results can be explored along several dimensions. In the first stage, we have considered some indicators from the spatial mismatch literature, generally applied to urban contexts. Their application in the European regional context has yielded a variety of results, for the different factors of production considered, for different territorial jurisdictions (regions and countries) and specific groups of countries (cohesion vs. non-cohesion).

Our study finds that the mismatch between the availability of regional population and the availability of physical capital for European regions is greater than the mismatch between the European regional population and the European regional labour force (on average about 20 per cent vs. 6.5 per cent respectively)[34].

Moreover, the evolution of regional SMIs shows that the convergence process of physical capital stock and labour with population is uneven. While labour shifts tend to be cyclical in line with economic development, the physical capital stock does not show the same cyclical behaviour. In both cases, however, the two factors of production considered are the main determinants of change and therefore of convergence or divergence between population and factors of production[35]. Consequently, it is important to note that production factors are not independent of population. In Europe, we have identified two spatial processes: labour follows population and physical capital stock follows population[36].

At the national level, the presence of a spatial mismatch between the factors of production and the population was determined based on the categorization of Cohesion and non-Cohesion. The SMIs distributions for these two groups of European countries exhibit a dual behaviour, indicating the existence of two clusters or 'clubs' of countries. Our research has shown that Cohesion countries have significantly higher values for the SMI of the stock of physical capital (values above 20 percent) than non-Cohesion countries (with values below 12 percent). Therefore, in the case of Cohesion countries, a

[34] It is important to note that the results obtained reflect an average of the very diverse European regions.

[35] Simply put, spatial adjustments or mismatches between population and production factors may occur due to interregional population movements and/or regional variations in physical capital and labour. However, for the case of the European regions, convergence or divergence is not determined by population movement.

[36] According to a referee, our exploratory approach suggests that the standard hypotheses of 'people follow jobs' or 'jobs follow people' (Carlino and Mills, 1987) may lean towards 'jobs follow people'. We also analyzed the hypothesis of 'people follow physical capital' or 'physical capital follows people' and found indications that 'physical capital follows people'.

larger percentage of the population would need to be relocated for the distributions of population and physical capital stock to be equal. Another significant difference is that, while the SMI for both capital stock and labour tends to converge over the period considered in Cohesion countries, in non-Cohesion countries, population and production factors tend to diverge. Therefore, the explanation for the existence of two types of European countries could lie in the location of regional production factors in relation to regional population, among other factors.

During the second stage of the analysis, we investigate the potential relationship between regional production factors and the regional distribution of population, and how this may contribute to both the existence of regional inequalities in Europe and the overall growth of the European Union.

The research from the estimated VAR model confirms that economic growth and reducing inequality are not inherently conflicting objectives. Based on the IRFs, our research does not detect a direct trade-off between European economic growth and inequality growth. The spatial mismatch between population and labour, which refers to the percentage of the population that needs to relocate for the labour distribution to match that of the European regional population, is the primary driver of the short-term dynamic relationships between the four endogenous variables. It has a crucial role in the trade-off between European economic growth and European economic inequality: increasing (reducing) the spatial mismatch between population and labour increases (reduces) economic growth, but also increases (reduces) economic inequality. This suggests that the trade-off between equity and efficiency arises from how production factors are allocated across regions[37].

In addition, our empirical analysis detected a significant positive interaction between the spatial mismatch for the European labour and the spatial mismatch for the European regional stock of physical capital, indicating that they complement each other. This would indicate that if the effects of employment policies and investment in physical capital are to be enhanced, it is necessary to accompany regional employment policies with physical capital endowment policies. From our findings, the distribution of labour and physical capital based on population criteria would reduce spatial mismatches for

[37] Our results would suggest that the integration of national economies within the EU is still facing challenges due to the existence of core regions that host modern production sectors and attract jobseekers, while peripheral regions are left with only traditional and local activities (Bratsberg et al., 2023; Ottaviano and Thisse, 2002).

labour and physical capital, but it would increase the growth of regional inequalities. However, the conventional approach to implementing regional policies, which distributes resources based on population-related criteria, does not effectively reduce regional economic inequality. Nevertheless, it benefits the aggregate economic growth.

1.7.- References

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CHAPTER 2. COMPONENTS OF POPULATION CHANGE IN THE SPANISH REGIONS

2.1.- Introduction

In recent years, the study of population changes and demographic dynamics has gained increasing prominence within both academic and political spheres. Scholars from diverse disciplines have approached this multifaceted issue from various angles, leading to an extensive specialized literature that delves into concepts such as "places left behind," "depopulation," "empty regions," "inward migration," and the examination of "shrinking localities."

The future of inhabitants in areas with a growing or declining population is shaped by demographic factors, which affect decisions related to public facilities, healthcare, education, and infrastructure (Alamá-Sabater, et al, 2021, Danko and Hanink, 2017). The age composition of the population contributes significantly to the trend of population change, which, in turn, impacts socio-economic and political decisions such as labour markets, service provision, and urban planning (Antczak and Lewandowska-Gwarda, 2019).

The future of inhabitants residing in areas that are either increasing or decreasing in population are profoundly influenced by demographic factors. These factors, in turn, play a critical role in decision-making related to crucial public services, healthcare, education, and infrastructure development (Alamá-Sabater, et al, 2021; Danko and Hanink, 2017). Among the critical demographic elements, the age composition of the population stands out as a significant driver of population change trends. This demographic composition exerts far-reaching effects on socio-economic and political determinations, encompassing labour markets, service provision, and urban planning considerations (Antczak and Lewandowska-Gwarda, 2019).

Furthermore, it is important to recognize that demographic trends in a specific area can spillover and influence neighbouring regions. Population flows have the power to shape local landscapes, making certain areas more attractive and accessible to different age groups. Conversely, population decline in neighbourhoods may lead to a loss of economies of scale in provision of essential services at the inter-territorial level (Terbeck, 2022).

It is therefore crucial that both policy makers and researchers acquire a thorough understanding of population change and population dynamics. This valuable knowledge forms the basis for policy making, providing the essential framework for promoting sustainable development and ultimately raising the well-being of communities.

The alarm has been sounded, and public administrations at the local, regional, national, and European levels are taking action by creating support structures and providing financial and technical resources to address the demographic challenge. This issue has become one of the most relevant policy lines for most public administrations at different levels. At the European level, population dynamics, along with population flows, are being closely investigated due to the presence of territorial imbalances. This issue is primarily a regional subject that affects certain areas of European countries, and the general framework corresponds to an integrated regional system that includes all European countries. Shrinking regions, in particular, are outstanding research included in ESPON 2020[38]. The spatial contextualization of population dynamics is being tackled through the idea of "Complex Shrinking" which refers to the study of clusters that consider the interaction of different fields, including geography, demography, and economic variables, to explain this phenomenon. The concept of "Complex Shrinking" goes beyond demographic contraction as it includes socio-economic changes (levels of economic activity and employment, sectoral structure, productivity, innovation, social capital, governance capacity, etc...), so it is not associated with remote places, but generally linked to specific types and scales of economic activity, structural change, skills availability, regeneration capacity, and adaptation processes, among others. The ESCAPE[39] project, within the ESPON program, identifies four common processes that lead to demographic decline after analysing experiences in various European contexts: economic restructuring (decrease of the agricultural workforce), locational disadvantage (a poor resource endowment, isolation, sparsity and proximity to borders),

[38] ESPON is an EU-funded programme that offers quality expertise to public authorities responsible for the design of territorial policies.

[39] ESCAPE (European Shrinking Rural Areas Challenges, Actions and Perspectives for Territorial Governance): project carried out during 2019-20 to analyse rural demographic decline in Europe with the aim of reassessing the justifications for EU-funded policy interventions within the changing multi-level governance landscape.

peripheralization (the consequence of macro-scale processes of spatial reorganisation of economic activity and globalisation) and disruptive events and political/ systematic transitions (e.g. the end of the socialist era in 1989, the Balkan wars in the 1990´s, or the EU integration process in the 2000s) (Copus, A. et al., 2021)..

This paper seeks to expand upon the concept of "Complex Shrinking" by including the spatial interaction of territorial areas as a relevant dimension. The aim is to explore to what extent the spatial interaction of local areas in terms of population change could determine a new typology of geographic areas that could be used to inform demographic strategy and policies related to the demographic challenge. To achieve this objective, we examine demographic change at the regional level, looking for distinct patterns that may provide evidence of different territorial behaviours and thus indicate the possibility of applying different policies to change population dynamics in certain areas. To enhance this exploratory population analysis, we introduce the spatial shift-share technique to identify how the behaviour of neighbouring areas and the spillovers generated by population flows influence population change. We apply this analysis to the context of Spanish provinces (NUTS-3), with each province's neighbouring areas defined as those with a common border.

The Bank of Spain, in its Annual Report 2020, recognizes the significant disparities that exist between the different Spanish provinces, not only in terms of their economic conditions, but also demographically (Albertos-Puebla, 2019, among others). Based on this survey and taking into consideration historical factors and other relevant elements, our study introduces new tools to define a regional typology that enhances the policy recommendations. Additionally, we are aware of other studies, such as those conducted by AVANT and FUNCAS, that analyses different areas with a focus on local territorial development, classifying regions (NUTS-2) and municipalities (LAU-2) based on their depopulation risk. However, none of these studies incorporate the spatial demographic environment of regions, which is a crucial aspect that our research aims to address.

The purpose of the rankings of demographic dynamics in regions is to identify policy guidelines that can improve the quality of life and reverse population trends. However, the failure to consider the spatial dependence of population flows among Spanish provinces limits the usefulness of these rankings. In order to design effective policies to influence population dynamics, it is necessary to determine the extent to which population changes fall within the jurisdiction of different levels of government. To the best of our knowledge, the literature review does not take into account the relationship between the different components of population changes and the policy involvement that could be assigned to each level of government.

In Spain, policies to influence population dynamic can be addressed at the local, regional, or national level. It is crucial to understand the governance of territories and the effectiveness of policies in the regional context. The national government makes decisions that benefit the entire country, while regional and provincial governments share decision-making responsibilities. To avoid overlap, knowledge of the sources of population changes and the nature of spill-over effects between provinces is important.

In addition to these levels of government, there is a “third political action” that affects neighbouring regions. These decisions are taken by a certain regional government, considering the interconnections between territories understanding the responsibilities between national and regional levels of government can lead to better policy recommendations. The provision of public services and infrastructures in the provinces should be approached while taking into account their geographical situation, environment, and population flows such as national or foreign immigrants. Bringing together the three contexts (national, regional, and inter-regional) could lead to a better understanding of how policies can be most effective.

The aim of this study is to identify the components of population change in Spanish regions using a modified spatial shift-share method proposed by Montanía et al. (2021). By detecting the territorial connections in population dynamics, we will be in a position to detect which level of government is best suited to modify population dynamics and recommend policies to fight against depopulation. Our main contribution is to explore the driving forces of demographic change and provide policy recommendations tailored to specific regional contexts.

Our approach is based on previous works such as Nazara and Hewings (2004), Ramajo and Márquez (2008), and Montanía et al. (2021), and our modified method incorporates demographic elements to account for spatial interactions between them. This methodology allows us to analyse the sources of population growth in Spanish provinces and contextualize population dynamics while considering the spatial patterns that emerge. We extend our study to three age cohorts: less than 16 years, between 16 and 64 years, and more than 64 years. The results can provide a diagnosis that informs regional policies tailored to different regional contexts (Amcoff, 2007).

The rest of the paper is structured as follows. The second section presents a review of the literature. The third section details the methodology, proposing an exploratory way to attempt to relate the effects detected with the level of government involved. Fourth section describes the databases used, showing the results of the empirical application. The discussion of the results is in Section 5. Finally, the main conclusions are detailed in the last section.

2.2.- Empirical background

Territorial studies have played a significant role in analysing the characteristics of different areas based on various factors. Territorial diagnostics provide policymakers with valuable tools to tailor policies to specific areas. By implementing these tools such as strategic plans about employment, networks, and other initiatives, population and economic activity dynamics can be improved, and places can become more attractive. To this end, programs are being carried out at European, national, and regional levels to deepen knowledge of territories and revive “left-behind places.” Functional urban areas (OCDE), DEGURBA project (Eurostat), URBAN AUDIT (Eurostat), FUNCAS, AVANT, are some of the programs aimed at classifying territories, municipalities, or cities primarily using demographic or economic trends. Building on this background, we propose a novel territorial classification of Spanish regions that distinguishes both the demographic trend attributed to the province itself and to the border province. This approach will provide a more comprehensive and nuanced understanding of the regions and facilitate the development of targeted policies that account for unique regional characteristics.

Scholars have extensively studied spatial connections within territories from various perspectives and at different administrative levels. At the local level, territorial linkages are recognized as a crucial factor for developing territories. The literature emphasizes the significance of introducing heterogeneity of territories in the construction of models, specifically in terms of urban-rural connections and the complexity of economic contribution. Spillover effects between areas based on their typology and economic specialization have also been explored to propose effective policies that improve the quality of life in territories (Alamá et al. 2022 a 2022b, Feser and Iserman, 2006). Meanwhile, regional administration has demonstrated the strong spatial component present in economic, demographic, and socio-cultural variables, as evidenced by specialized literature and official reports. Consequently, demographic spillovers should be considered in forecasting regional demographic trends and rankings. Population trends in an area are not only influenced by local factors but also by neighbouring effects. Therefore, it is crucial to account for demographic spillovers in policy-making to improve the quality of life in territories (Alamá et al, 2021, Cities)

We use spatial shift-share analysis to analyse the pattern of provincial population growth in Spain between 2015 and 2020, decomposing population changes according to three effects: national, province neighbourhood and regional. The methodology takes as point of departure Montanía et al. (2021). This method will be adapted for the analysis of population change. The proposal will be illustrated by analysing population changes in Spanish provinces (NUTS-3 level) according to three age cohorts: population under or equal to 14 years old, population between 16 and 64 years old and population over or equal to 65 years old.

Shift-share analysis (SSA) is a statistical technique that has traditionally been used to study changes in socio-economic variables. The first ideas related to this technique correspond to Mc Dougall (1940), Jones (1940) and Creamer (1943) although its popularity within Regional Science is reached from Perloff, Dunn, Lampard and Muth (1960). Hewings (1976) recognised the importance of including space in SSA, proposing the first analysis in Nazara and Hewings (2004) where the decomposition of the growth ratios of economic variables includes simple effects (within the same geographical area or the same sector of activity within a region) and combined effects (different geographical areas and different sectors) which, although interesting because they take into account the geographical and sectoral dimension, make it difficult to choose the appropriate decomposition. Some extensions have emerged, among others Espa, Filipponi, Giuliani and Piacentino (2014); Herath, Schaeffer and Gebremedhin (2013); Matlaba, Holmes, McCann and Poot (2014); Mayor and López (2009); Ramajo and

Márquez (2008); that have mainly focused on the development of a single decomposition that considers only simple effects.

Spatial shift-share analysis is considered an effective tool for regional analysis. It is very intuitive and does not require much information, yet it provides a diagnosis of the different contributions to structural change in a regional economy taking into account, in addition, the effects of neighbouring regions. In other words, this type of analysis provides insight into the origin of the growth of an economic variable at the regional level, thus making it possible to formulate integrated regional economic policies within an interrelated regional system.

Montanía et al (2021) provide a particular version of the spatial shift-share analysis, focusing on all possible simple effects of the decomposition of the Gross Agricultural Value Added (GAVA) at the regional level (NUTS-3) in Spain during the period 2013-2017. In doing so, it extends Boudeville's (1966) classification by making it possible to catalogue regions according to their behaviour; that is, by identifying the characteristics of each type of region that will allow the formulation of hypotheses about the drivers of economic growth. It therefore constitutes a diagnostic tool for the design of regional policies from three geographical contexts: national, neighbourhood and regional.

Shift-Share methodology has been applied to demographic context, mainly to study the composition of ethnic groups that contribute to population change in certain areas, which population group is the source of population growth or decline. (Franklin, 2014, Danko, J. J. and Hanink, D. M. (2017), Terbeck, F. J. (2020)). These authors decompose population considering spatial shift-share technique and compare the change that is attributable to regional, local, and neighbour sources. Additionally, Frankling (2014), use shift-share methodology to decompose population change attending to three components: National effect, cohort mix effect, “that captures cohort population change attributable to a state’s specialisation in cohorts that are growing fast at the national level”, (Frankling, 2014) and a competitive effect.

Our work takes as a reference the research of Montanía et. al (2021) and Frankling (2014) to present a new classification of the provincial population (NUTS-3) that will have as reference the nation, the neighbourhood and the region/provincial. Our interest is to detect the “province specialization” in cohorts attending to three contexts: national, neighbourhood and province context.

Thus, the results of our analysis are expected to reveal diagnoses about the performance of each region, showing which of the different geographical contexts are generating the sources of population or depopulation and so, approximating political responsibility. With this, we would be contributing to the economic literature on depopulation, complementing other classifications such as those proposed in FUNCAS (2021) by Bandrés E. and Azón V. in "La despoblación de la España interior" where depopulation is addressed based on demographic and economic characteristics of the Spanish provinces from 1950 to 2019 and which allows us to classify the 23 Spanish provinces that make up depopulated Spain into three groups (the Spain that is shrinking, the Spain that stagnates ,the Spain that grows). Ródenas and Martí (2005) also propose a classification of the 23 provinces that make up depopulated Spain based on the characteristics of migratory movements. The cluster analysis divides these provinces into six groups depending on migration balances and emigration/immigration rates. However, none of the previous studies has considered the spatial heterogeneity and its subsequent effects.

2.3.- Methodology

2.3.1.-Definitions

As mentioned in the previous sections, shift-share decomposition allows to determine to what extent population change in each area is influenced by the different effects related to its geographical contexts (both national and spatial). The present study has two main goals, first, assessment of demography behaviour in terms of age-cohort by Spanish provinces, detecting the province specialization in cohorts age, that is, the source of population changes during period 2015-2020. Second, the study will investigate the nature of this specialization, distinguishing between structural (cohort mix) and competitive effects. This knowledge allows for the adjustment of demographic policies to the characterization of each area, detecting what is the appropriate hierarchical spatial level where the policy involvement should be focused.

Traditionally, shift-share analysis is a tool for interregional comparison. It is usually used to measure regional or sectoral competitiveness, both within a national framework and individually between regions. To do so, the analysis breaks down the variation of the economic variable over a period of time (usually five years or less) into three effects: national, structural, and regional (or competitive) effects This approach has been applied in a variety of research fields, including regional employment, sectoral production, regional productivity, international trade, demography, and ethnicity (Frankling, 2014 and other papers).

As it has been explained in previous section, the spatial Shift-Share method will be our methodological starting point. Adapting the method proposed in Montanía et al (2021), the purpose is to analyse provincial population growth in Spain, isolating the effects of the nation, neighbouring provinces, and the province itself.

The following expression shows the classical shift-share decomposition for the absolute population change associated to age cohort i and province r, in t+n. Adapting the terminology to the population context (see Franklin, 2014), the three classical effect are:

$$g_i x_{i,r}^t = G x_{i,r}^t + (G_i - G) x_{i,r}^t + (g_i - G_i) x_{i,r}^t = NE + CME + CE \quad (1)$$

Being:

g_i : growth rate on population in age cohort i and province r.

G_i : is population national growth in age cohort i

G: is national population growth

NE: National effect

CME: Cohort mix effect.

CE: Competitive effect

Expression (1) concepts are defined as following:

National effect (NE= $Gx_{i,r}^t$) represents the part of the absolute population growth in t+n, in province r and in age cohort i, which is attributable to the national population context, thus associated with policy decisions taken at the **national level**.

Cohort mix effect (CME) (CME=$(G_i - G)x_{i,r}^t$): represent the part of the absolute population growth in t+n, in province r and in age cohort i, which is attributable to the difference between the population growth of a certain age cohort and total population at national level. This part is also related to policy decisions at national level.

$G_i > G$, indicates that a part of absolute variation of population aged cohort i, in province r is consequence of positive behaviour, at national level. In case, $G_i < G$, the negative sign of SE denotes that there are structural problems in age cohort i, so the policy recommendation will be directed towards improving the situation of age cohort i **(national policy**).

Competitive effect (CE) (CE=$(g_i - G_i)x_{i,r}^t$) represents the part of the absolute population growth in t+n, in province r and in age cohort i, which is attributable to the difference between population growth in province r for the age cohort i, and population growth for the same age cohort at national level.

$(g_i > G_i)$ indicates that in province r, part of the absolute variation in the age cohort of population i is attributable to the regional advantages of province r relative to national performance. In case, $(g_i < G_i)$, province r, should consider tackling regional policies addressed to improve a give age group **(Regional policies)**.

In summary, the classical decomposition of population growth of areas highlights which component contributes to population growth or decline in each age group and in each province. The sign of each component will be a good indicator to determine the nature of the policy that will lead to a change in population dynamics.

Montanía et al. (2021) and other scholars suggest that the classical shift-share technique could be improved by complementing their inherent national context with their corresponding neighbouring context. As mentioned above, the spatial dependence of population dynamics makes it necessary to include in our demographic application a measure of the demographic behaviour of neighbors. In the regional context, people move to neighbouring regions to benefit from their services. Working, studying, living, etc. are examples of reasons for population movements across regional borders.

Consequently, the spatial shift-share proposed in Montanía, et al. (2021) is described as following:

$$g_i x_{i,r}^t = \left[wg x_{i,r}^t + (wg_i - wg)x_{i,r}^t + (g_i - wg_i)x_{i,r}^t\right]$$
$$+\left[(g_i - g)x_{i,r}^t + (g - wg)x_{i,r}^t + (wg - g_i)x_{i,r}^t\right]$$
$$= NC + RC = NTE + NCM + NCE + RCM + RNE + RE \quad (2)$$

The weight matrix, denoted by w, represents the first-order connection between neighbouring provinces. It characterizes the neighbourhood structure that connects provinces by sharing a common border. Expression (2) allows to divide the absolute population change in each age cohort and in each province into six components.

As in Montanía, et al (2021) the propose is to analyse interaction composed by simple effects, interactions composed by the same territory or the same age cohort[40]. Equation (2) calculates the competitive effect and the cohort mix effect in the "neighbourhood context" and in the "regional context". Population cohort change in each province is explained attending to, neighbourhood context and regional context. In our proposal, the effects will be adapted in order to provide a convergence between the spirit of the spatial expression of Montanía et al (2021) and the approach shown in Franklin (2014), whose author takes into account the specific characteristics of a demographic analysis. Therefore, our spatial shift-share analysis will consider the contribution of each component to the population growth of each cohort age in each Spanish province. The six components of the population absolute change are defined as following:

Firstly, we define two aggregate parts:

1) Neighbourhood context (NC)
2) Regional context (RC)

In the neighbourhood context (NC) of expression (2) three parts are distinguished:

1.1) Neighbourhood total effect (NTE)
1.2) Neighbourhood cohort mix effect (NCM)
1.3) Neighbourhood competitive effect (NCE)

The explanation of each three parts are as follows:

Neighbourhood total effect (NTE= $wgx_{i,r}^{t}$): represents that part of the absolute population change in age cohort i and province r that is attributable to the total population growth rate in the neighbouring provinces of province r. Thus, the population corresponding to this component depends on the regional factors associated with the surrounding provinces. If the population in the surrounding area is growing and, therefore, g>0, province r will benefit from the good neighbourhood situation.

[40] We substitute the structural mix effect used by Montania by cohort mix effect used by Franking, 2014

Commuting and accessibility between regions will facilitate the growth of this part of the population. This is the case for provinces located close to a dynamic region with high availability to attract population. It should be borne in mind that, in this case, the province r does not have the power to act on population growth in neighbouring areas. However, inter-territorial population attraction policies could be articulated for the benefit of neighbouring areas.

Neighbourhood cohort mix effect (NCM =$(\boldsymbol{wg_i - wg})\boldsymbol{x_{i,r}^t}$): represent the part of the absolute population change in age cohort i and province r, that is explained by factors specifics to that age cohort in the neighbouring provinces of province r. This effect assesses whether in these neighbouring provinces a specific age group i is growing faster or slower than the total population of the neighbouring provinces. Positive values ($wg_i > wg$) indicate that province r could benefit from the presence of neighbours with competitive and dynamic behaviours in that age cohort. Negative values indicate that non-dynamic behaviours in that age cohort slow down population growth in the same age group in province r. Therefore, negative values ($wg_i < wg$) would indicate that there are structural problems in a given age cohort in regions surroundings of province r, which would imply the need to analyse the geographical context and promote **specific inter-territorial policy recommendations for a given age cohort (interterritorial policies)**, so that the situation of neighbours does not detract from region i's growth capacity.

Neighbourhood competitive effect ($\boldsymbol{NCE = (g_i - wg_i)x_{i,r}^t}$): measures the part of the variation in the absolute population change in age cohort i and province r, explained by competitive factors in the region. It compares the growth ratio of a given age cohort in province r and neighbouring provinces. If $g_i > wg_i$, indicates that in province r, population growth in a given age cohort is higher than in the surrounding areas, so that this age cohort has a dynamic behaviour compared to its neighbors. If $g_i < wg_i$, indicates that population of age cohort i, moves to the surroundings area, so there are competitive effects with neighbouring provinces that can be solved applying **local or regional policies specifics to these age group (sectoral competitive policies).**

In relation to the regional context of expression (2) three parts are distinguished:

2.1) Regional cohort mix (RCM)

2.2) Regional neighbourhood effect (RNE)

2.3) Residual effect (RE)

The definitions of each part are as follows:

Regional cohort mix (RCM =$(\boldsymbol{g_i - g})\boldsymbol{x_{i,r}^t}$): measures the part of the variation in the absolute population change in age cohort i and province r explained by structural factors in the same province r. Positive values, $(g_i > g)$, indicate that a given province has comparative advantages for a given age cohort i. Negative values, $(g_i < g)$, indicate structural problems of that cohort compared to total population growth. In this case, policy recommendations, in the regional context, should be aimed at improving conditions for cohort i in province r (Its performance is related to regional policies).

Regional neighbourhood effect (RNE= $(\boldsymbol{g - wg})\boldsymbol{x_{i,r}^t}$): measures the part of the variation in the absolute population change in age cohort i and province r explained by the difference between the total population growth rates in province r and neighbouring provinces. Positive values, $(g > wg)$, indicates that total population in province r is growing faster that in surrounding areas. Negative values $(g < wg)$ indicate that neighbouring provinces are more competitive. In this case, these regional disadvantages would be solved by designing policies to boost total population growth in province r (Regional competitive policies).

Residual effect (RE= $(\boldsymbol{wg - g_i})\boldsymbol{x_{i,r}^t}$): measures the part of the variation in the absolute population change in age cohort i and province r explained by the difference between total population growth rates in neighbouring provinces and the growth rate in a given age cohort in province r.

2.3.2.- Components of population change and an approximation to policy involvements

The main purpose of this paper is to identify the sources of population changes at the provincial level. As described in Section 2.3.1, expressions 1 and 2 provide the demographic components of population changes. Table 2.1 summarizes the policy involvement of each component defined in the previous section. This information is crucial for diagnosing the structure of Spanish provinces and adjusting policy territorial strategies to improve demographic conditions for each age cohort.

In the national context (traditional shift-share), the cohort mixing effect (CME) is composed of the difference in the growth rate of the population corresponding to a certain age cohort and the total population. As the growth rate is at the national level and the differential between an age cohort and the total population is being compared, the policy implication is structural and at the national level. The competitive effect (CE) compares the differential between the regional and national growth rates for the same age cohort. In this sense, the assigned policy levels are regional and national.

In the neighbourhood context, the cohort mix effect (NCM) is the differential of the growth rate of the neighbor's population with respect to the age cohort and the total population. As such, the policies to be implemented must be inter-territorial in nature. The competitive effect (NCE) is the differential of the regional and neighbor's population growth rates for the same age cohort. In this case, the policy implications are both regional and inter-territorial.

Regarding the regional context, the first component is the regional cohort mix (RCM), where the growth rate differences are at the regional level and related to the age cohort and total population. Therefore, the policy implications are exclusively regional in nature. The competitive component (RCE) has policy implications at both the regional and interregional levels since it is composed of the regional and neighbor's total population growth rates. Table 2.1 summarizes the policy implications for each context and component.

Table 2.1 Nature on policy typology of population components of classical and spatial Shift-share

Context	Population growth component	Policy Involvements	Characteristics
NATIONAL CONTEXT	CME $(G_i - G)$	Structural national policy	Depending on age cohort, measures to improve conditions to age cohort i
	CE $(g_i - G_i)$	Regional and national policy	Depending on age cohort, measures to attract or retain population of age cohort i
NEIGBOURHOOD CONTEXT	NCM $(wg_i - wg)$	Interterritorial policy	Depending on age cohort, measures to improve demographic conditions of age cohort i in neighbouring areas
	NCE $(g_i - wg_i)$	Regional and interterritorial policy	Depending on age cohort, local or regional policies specifics to these age group (sectoral competitive policies).
REGIONAL CONTEXT	RCM $(g_i - g)$	Regional policy	Depending on age cohort, in the regional context, should be aimed at improving conditions for cohort i in province r
	RNE $g - wg$	Regional and interterritorial policy	Depending on age cohort, regional disadvantages would be solved by designing policies to boost total population growth in province r

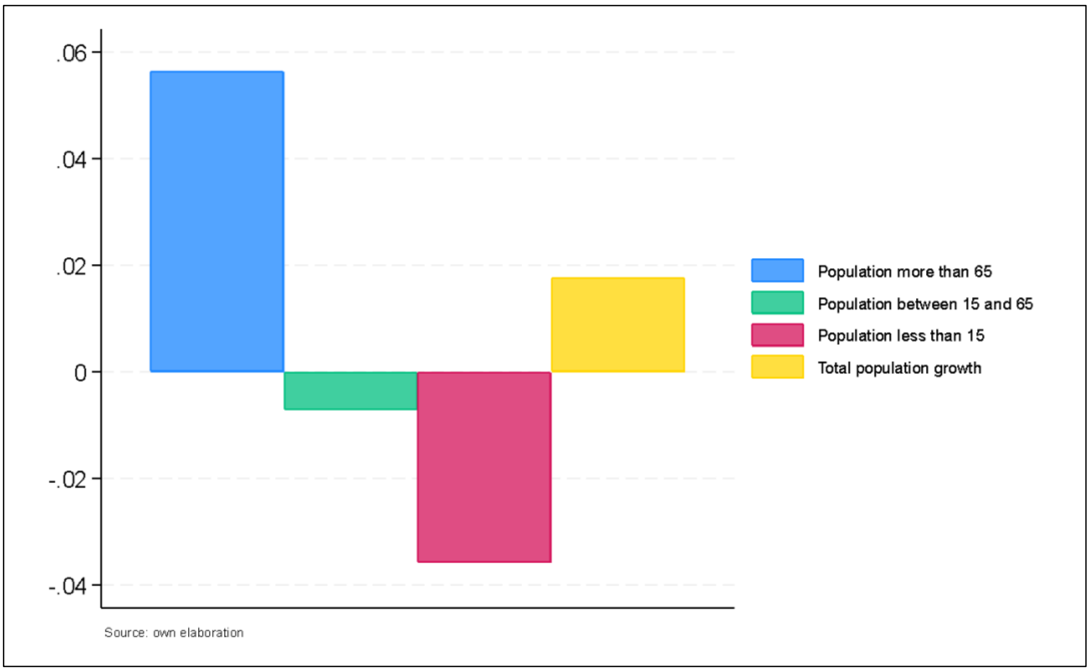
Source: Own elaboration

2.4. Data and empirical application

2.4.1.- Description of data

This study is applied to the Spanish context, therefore analyses the demographic trends of Spanish provinces based on statistical data obtained from the Continuous Register Statistics (Spanish Statistic Institute, INE) for three age groups (under 16 years, between 16 and 64, and over 65) and fifty Spanish provinces (NUTs 3) in the years 2015 and 2020. The total population and population by age in the period under review showed a moderate population increase of around 2%, but the growth was characterized by disparities across age groups. The population under 16 declined, while the population between 16 and 64 grew moderately at 1%, and the population over 65 grew by nearly 8% (see Figure 2.1). These results confirm the theory of demographic transition already occurring in Europe, where the older age groups experience the largest population increase, while the share of the working-age population decreases (Amcoff and Westholm, 2007).

Figure 2.1 Total population growth rate in Spain, 2015-2020



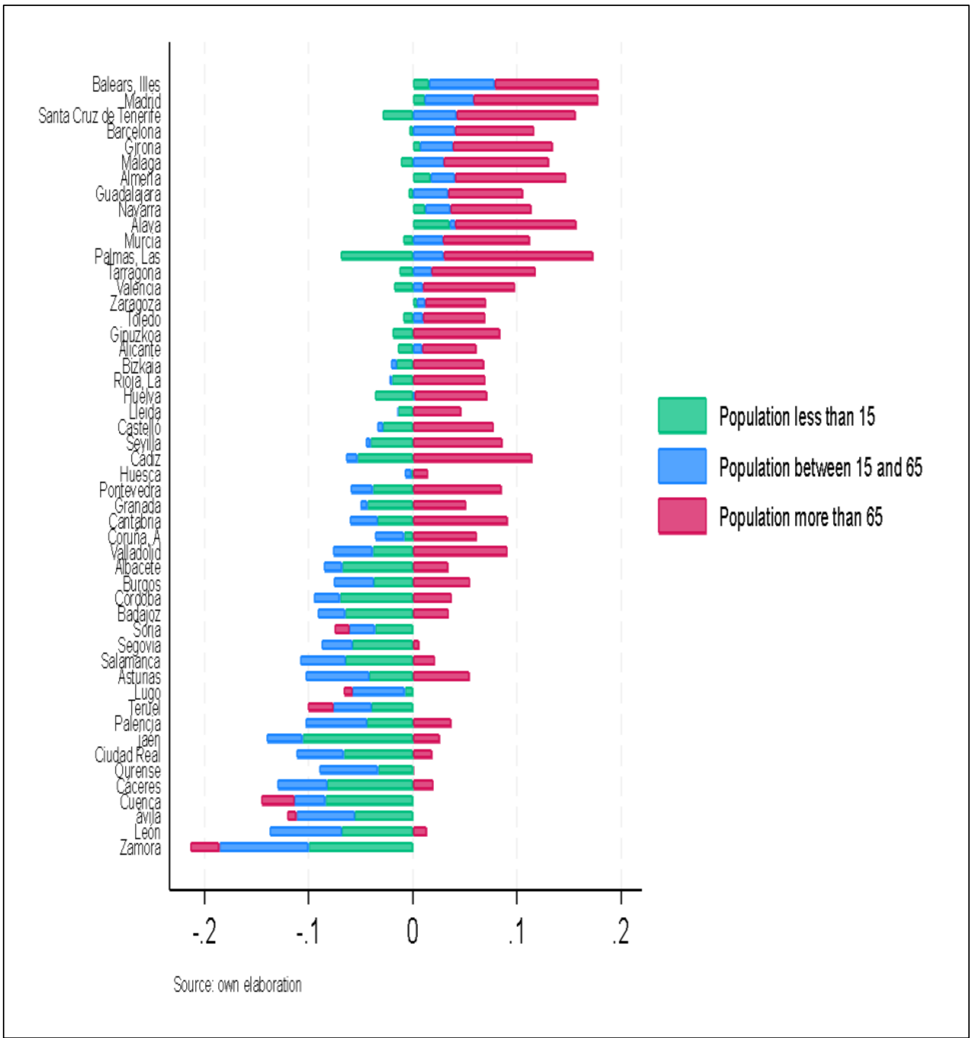
Source: Own elaboration with data of INE

Figure 2.2 displays the provinces ordered by their population growth rate between 2015 and 2020 in descending order and illustrates the contribution of each age group to the provinces' population change during that time period. The results show that the population under 16 years old (represented by green bars) had a negative contribution in most provinces, with some exceptions where this age group contributed to the overall population increase (e.g., Girona, Almería, Navarra, Alava, and Zaragoza). The working-age population (represented by grey bars) made a positive contribution to population growth in growing provinces, but a negative contribution in declining provinces. Meanwhile, the population over 65 years old (represented by red bars) had a positive contribution in most Spanish provinces, except for those with the highest population decline, such as Zamora, Avila, Cuenca, Teruel, Lugo, and Soria, where the influence of this age group was negative.

In summary, Figure 2.2 provides insights into the cohort specialization of each province by showing their contribution to population change. For declining provinces, except for those mentioned earlier, the population over 65 is the age cohort that helps prevent further decline. Conversely, in growing provinces, the population between 16 and 64 years and over 65 is responsible for growth rates. This behaviour reflects a diverse demographic pattern across age cohorts and provinces, and a “province specialization.” However, the nature of this specialization is unclear. Is it due to a cohort mix effect (structural), or a competitive effect?

The population over 65 is contributing to the population growth in most provinces, but what is the nature of this growth? Is it due to a cohort advantage or a competitive advantage? Similarly, in growing provinces, the population between 16 and 64 is contributing to total population growth, while the opposite is true for declining provinces. Is this due to a cohort mix effect or a competitive effect? By analysing the results, we can identify the source of population growth and understand whether it is the result of a specific cohort or a competitive advantage.

Figure 2.2 Sources of Population change, measured by percentage 2015-2020 (by age cohort)



The spatial dependence of population dynamics was examined by calculating Moran's I statistic (Moran, 1948) for the population growth in the three age cohorts (population less than 14, between 16 and 64, and more than 65) in the period between 2015 and 2020. The results presented in Table 2.2 emphasize the significance of the neighbourhood context in the analysis of demographic patterns in Spanish regions. Positive spatial correlation was found for the growth of each cohort, suggesting that provinces with similar growth rates tend to be geographically clustered. This leads to the hypothesis that there may be underlying factors linking the growth rates of a province's population to those of neighbouring provinces. Thus, the spatial Shift-Share Analysis approach should be used to account for the neighbourhood effects of Spanish provinces, which are relevant components of population change.

Table 2.2 Moran's I for the population growth of every age cohort

Age cohort's	Moran's I
Less than 16	0.353***
Between 16 and 64	0.492***
More than 65	0.119***

Source: Own elaboration

2.5.- Results

2.5.1.- General Issues

In this section, we present the results for the demographic components proposed in this paper, focusing on the three age cohorts, and covering all 50 Spanish provinces. Results are analysed classifying provinces in terms of total population growth rate between 2015 and 2020 and divide them into two categories: declining regions (negative sign) and growing regions (positive sign) (Danko and Hanink, 2017). Figure 2.3 shows a map of the Spanish provinces colored according to whether they are declining (green) or growing (yellow) during the period under consideration.

In Annex A and B is listed the demographic components and their contributions to population change in each province. It should be noted that the value of these components is biased by the size of the population in each province, so they cannot be used for interprovincial comparisons. In Annex A we list the results of classical shift-share effects, National effect, cohort mix effect and competitive effect, for each one of the provinces and cohort age (see Annex A). In Annex B we describe, the six components associated with the spatial context.

To compare the relative importance of each component across provinces, we have generated a new variable called TOTAL_NAC, which is the sum of NE, CME, and CE in absolute terms. We have then divided each component by TOTAL_NAC to get an idea of its contribution and enable interprovincial comparisons.

National context

$$POPCH = NE + CME + CE$$

$$TOTAL\_NAC = abs(NE) + abs(CME) + abs(CE)$$

$$SHNE = \frac{NE}{TOTAL\_NAC};\ SHCME = \frac{CME}{TOTAL\_NAC};\ SHCE = \frac{CE}{TOTAL\_NAC} \qquad (3)$$

Spatial context

$$POPCH = NTE + NCM + NCE + RCM + RNE + RE$$

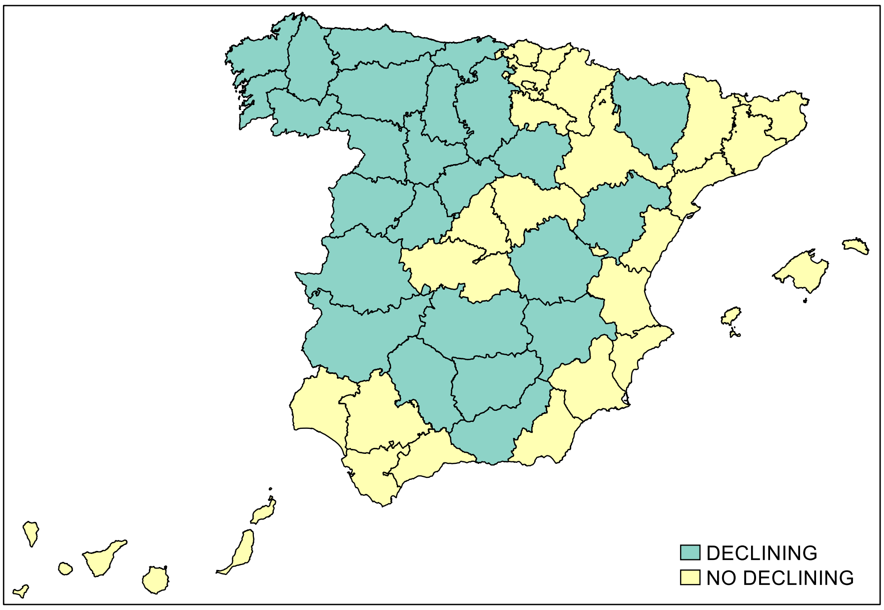
$$TOTAL\_SP = abs(NTE) + abs(NCM) + abs(NCE) + abs(RCM) + abs(RNE) + abs(RE)$$

$$SHNTE = \frac{NTE}{TOTAL\_SP};\ SHNCM = \frac{NCM}{TOTAL\_SP};\ SHNCE = \frac{NCE}{TOTAL\_SP}$$

$$SHRCM = \frac{RCM}{TOTAL\_SP};\ SHRNE = \frac{RNE}{TOTAL\_SP};\ SHRE = \frac{RE}{TOTAL\_SP} \qquad (4)$$

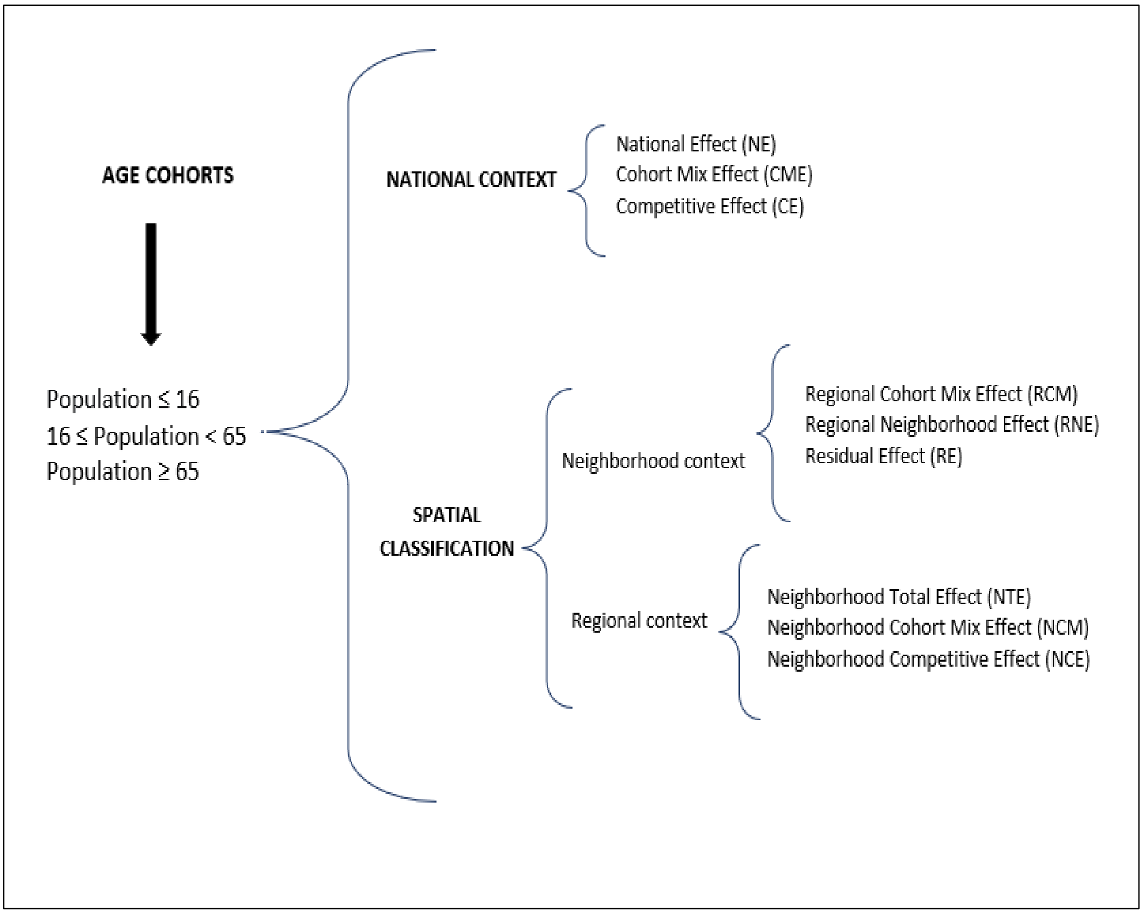
Our primary objective is to unearth patterns within demographic components that shed light on population changes, particularly concerning age cohorts. This endeavor will enhance our comprehension of demographic processes and the variances in population trends. To assess the significance of differences between the two groups of provinces (declining and growing) we conducted a one-way analysis of variance (ANOVA).

Figure 2.3 Declining and growing Spanish provinces, 2015-2020.



Source: Own elaboration

Figure 2.4 Classification of national and spatial context.



Source: own elaboration

2.5.2.- Classical shift-share approach: National Context

Based on the components calculated in expression (TOTAL_NAC), Figures 2.5, 2.6, and 2.7 present the three-age cohort data in the context of national demographic trends (structural and competitive effects). The dashed line in the figures separates provinces with positive total population growth (above) from those with negative growth (below). By comparing these figures, two main observations can be made:

- The driver of population change is different in term of age cohort.
- The pattern of population change between growing and declining province are not similar.

Figure 2.5 shows that the population under 16 years of age in all Spanish provinces exhibits a negative national cohort mix effect (CME). While this effect drives population growth in growing provinces, it detracts from growth in all provinces (suggesting that the population under 16 faces structural problems in all Spanish provinces). As a result, improving the demographic dynamics of this age group should be a priority policy recommendation. According to table 2.2, in order to increase the population of children under the age of 16, there are several measures and policy recommendations that could be considered.

Table 2.3 presents the analysis of a one-way ANOVA to examine the differences in the average CME component between declining and growing provinces. Column 2 indicates the F-statistics, with the corresponding p-value in brackets. Column 3 details Bartlett's test for checking the assumption of homogeneity of variances. Column 4 shows the Bonferroni comparison between the average CME in non-declining and declining provinces.

In the case of CME, the result is reinforced by one-way ANOVA, which shows significant differences in the average CME component between declining and growing provinces (see Table 2.3). Interestingly, provinces with the greatest structural problems are the ones experiencing population growth (CME is negative in the two groups).

In Figure 2.5, the competitive effect (CE) is mostly positive in growing provinces, while declining provinces generally show negative competitive effects, with some exceptions. Table 2.3 confirms these observations, indicating significant differences in the average competitive effect between declining and growing provinces. In conclusion declining provinces are facing with competitive problems. Therefore, these areas should implement regional and national policies aimed at attracting population and increasing population growth in this age group above the national level, as suggested in Table 2.2.

Figure 2.5 Classical Shift-Share components contribution to population cohort age (less than 16)

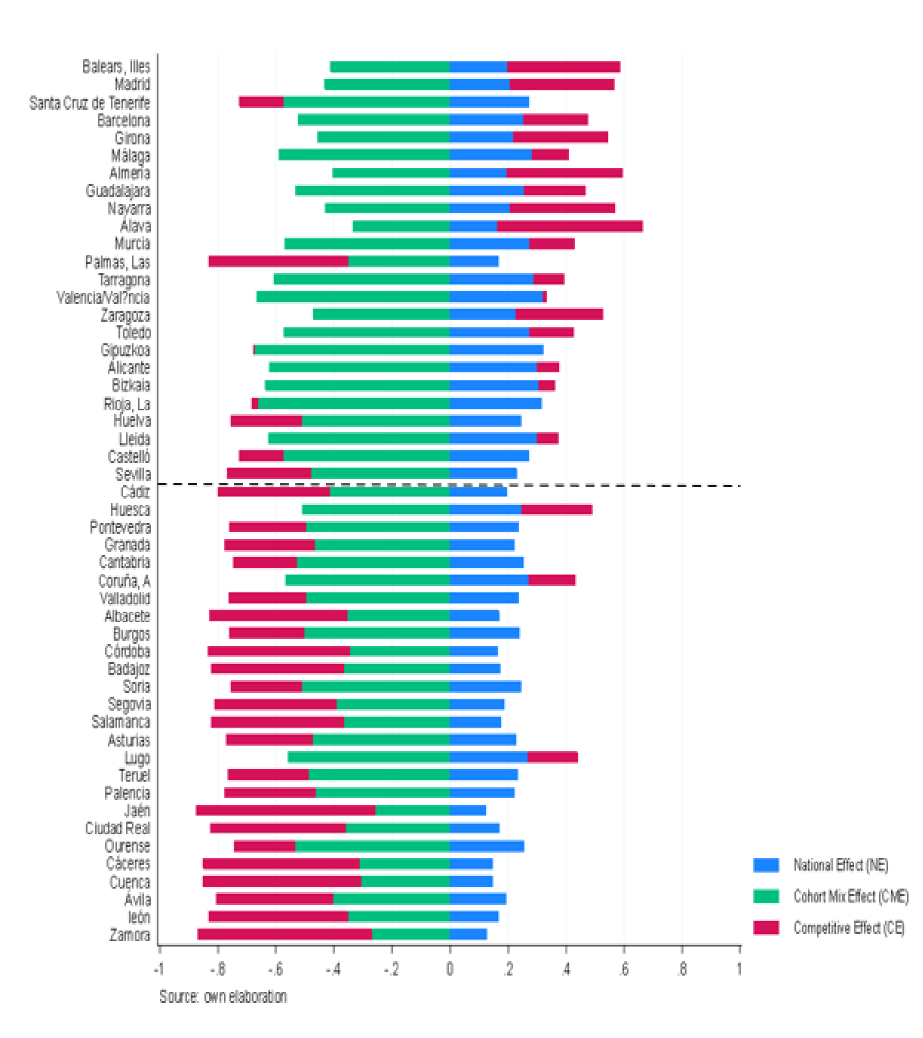


Table 2.3 One Way Anova: population less than 16
(two groups: provinces with non-declining population, provinces with declining population)

	F statistic	Bartlett's equal variances (CHI2)	Bonferroni comparison (non-declining-declining)
CME	12.64*** (0.00)	0.153 (0.696)	-0.098
CE	34.65*** (0.00)	0.366 (0.545)	0.407031

P-Value in brackets

Source: Own elaboration

Figure 2.6 shows a different pattern for the population between 16 and 64 years old. Although the cohort mix effect (CME) is negative for all provinces, it is not the main driver of population change in this age group. One-way ANOVA is not applicable here due to unequal deviations in each group, which is influenced by outlier behaviour in certain provinces. Nevertheless, the negative contribution of this effect to population change suggests that policy recommendations should focus on improving the demographic dynamics of this age group. Table 2.2 highlights the need for national-level political involvement in this matter.

According to Figure 2.6, the competitive effect (CE) varies across provinces, with some displaying positive and others negative signs, as shown in figure 2.6. Provinces situated in the top (with positive growth) exhibit higher and positive values of CE, indicating that it is the main driver of their growth. Conversely, in provinces with negative population growth, the CE component becomes the primary detractor of population. However, due to unequal variances in each group, one-way ANOVA (Table 2.4) cannot be applied to this context. Nevertheless, the negative provincial competitive effect emphasizes the need for regional and national policies aimed at improving the relevant age cohort. Therefore, it is essential to attract population and increase population growth in this age group above the national level.

Table 2.4 One Way Anova: population between 16 and 64 (two groups: provinces with non-declining population, provinces with declining population)

	F statistic	Bartlett's equal variances (CHI2)	Bonferroni comparison (non-declining-declining)
CME	51.06*** (0.00)	7.89*** (0.005)	-0.085
CE	86.10*** (0.00)	34.83*** (0.000)	0.740

P-Value in brackets

Source: Own elaboration

Figure 2.6 Classical Shift-Share components contribution to population cohort age (between 16 and 64)

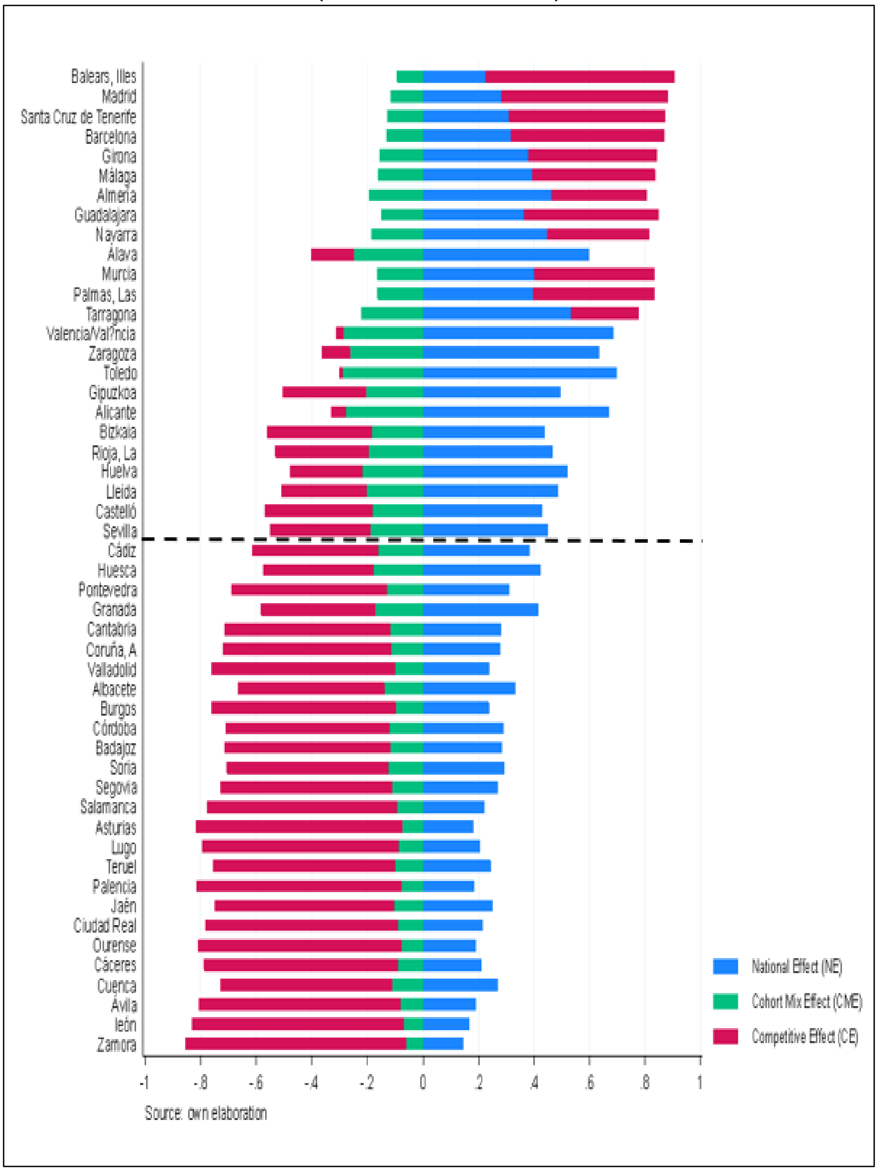


Figure 2.7 illustrates the impact of the national cohort mix effect (CME) and the national competitive effect (CE) on the population change of the cohort of individuals over the age of 65 in Spanish provinces. The CME, which is positive in all provinces, is the primary driver of population change in this age group, suggesting that the structural effect is contributing to population growth across the board. Furthermore, the one-way ANOVA (Table 2.5) test reveals significant differences in the mean CME, with non-declining provinces exhibiting higher values than declining ones.

In terms of the competitive effect (CE), most growing provinces display a positive effect, but the small magnitude suggests that it does not significantly contribute to population change. However, declining provinces face challenges related to the competitiveness of this age group, as their negative values detract from their growth potential. The low or negative competitive effect necessitates the implementation of regional and national policies aimed at improving this cohort's quality of life, attracting new residents, and driving population growth beyond the national average. The one-way ANOVA confirms that the mean differences are statistically significant.

Figure 2.7 Classical Shift-Share components contribution to population cohort age (more than 65)

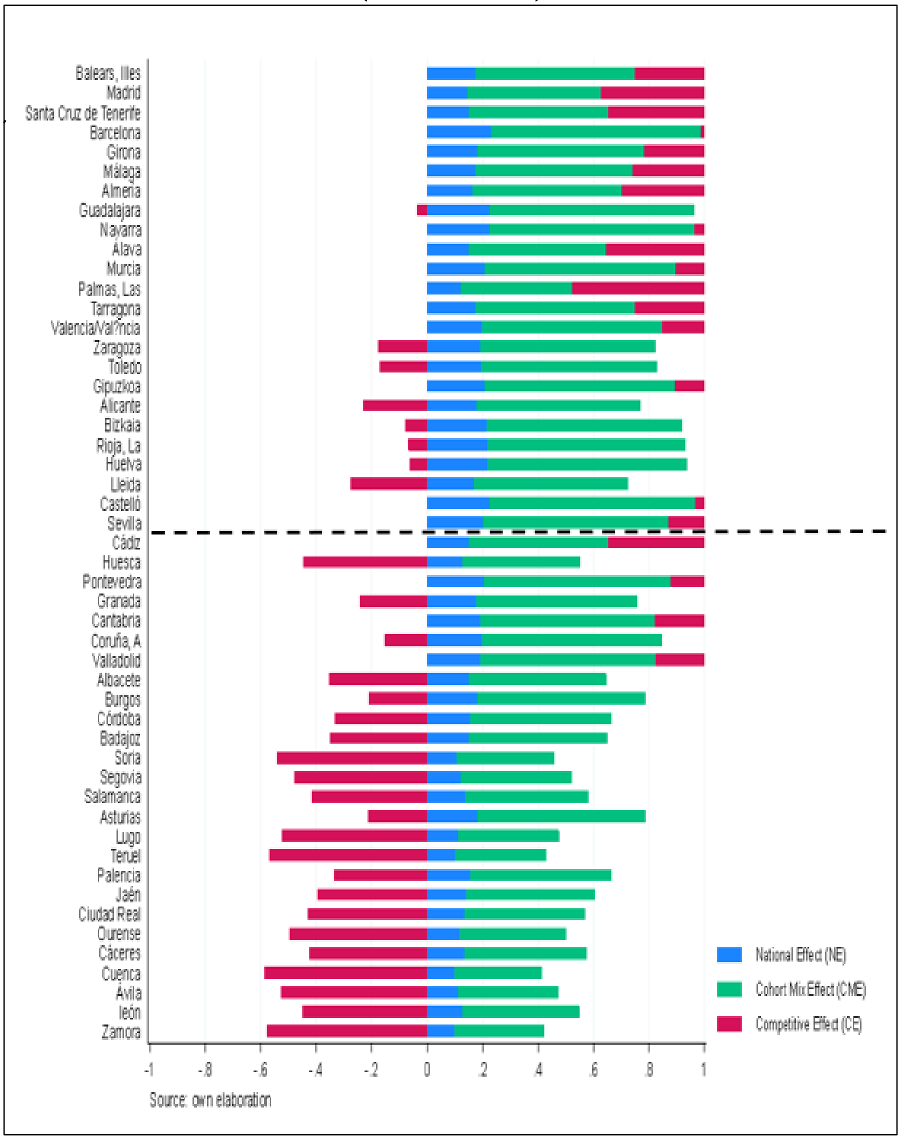


Table 2.5 One Way Anova: population more than 65
(two groups: provinces with non-declining population, provinces with declining population)

	F statistic	Bartlett's equal variances (CHI2)	Bonferroni comparison (non-declining-declining)
CME	23.44*** (0.00)	0.3862 (0.534)	0.144
CE	53.96*** (0.00)	0.0952 (0.758)	0.450

P-Value in brackets

Source: Own elaboration

2.5.3 Spatial shift-share approach: neighbourhood and regional context

2.5.3.1 General Issues

According to Equation 2, the population change in each province by age cohort is influenced by two contexts, namely neighbourhood and regional. Each context comprises three components, namely neighbourhood total effect (NTE), neighbourhood cohort mix (NCM), neighbourhood competitive effect (NCE), regional cohort mix (RCM), regional competitive effect (RNE) and residual effect (RE), which are defined in Section 3. The inter-territorial level replaces the national level in this expression. Population flows are considered as an additional element contributing to population change, as a consequence of the spillovers generated between provinces. By studying inter-territorial relations and analysing the components of the spatial shift-share, it is possible to determine the sources of population change and adapt political involvement to the demographic strategy in order to address demographic challenges.

The results of the empirical application of Equation 2 for the three-age cohorts in each Spanish province are presented in Figures 2.8, 2.9, and 2.10. The effects of cohort mix and competition within each context, namely neighbourhood and regional, are shown for each age-cohort.

2.5.3.2 Population under 16

2.5.3.2.1 Cohort mix effect (neighbourhood and regional context)

Regarding the neighbourhood cohort mix (NCM) component, it is worth noting that for the age cohort under 16, the value is negative, which implies that NCM is decreasing the growth potential of this age group, except in Pontevedra, as shown in Figure 2.8. However, when comparing the declining and growing provinces, the one-way ANOVA (Table 2.7) suggests that there are no significant differences in mean terms between the two groups of provinces regarding NCM.

To reverse this situation and change population dynamics, regions should implement age-group specific inter-territorial policies. In this sense, improving population dynamics for age cohorts with lower growth rates relative to the total population of neighbouring provinces can avoid inter-territorial backward effects.

Figure 2.8 indicates that for the age cohort corresponding to the population under 16 years of age, most provinces exhibit a negative regional cohort mix (RCM). The one-way ANOVA (Table 2.7) confirms that there are significant differences between non-declining and declining provinces. Additionally, non-declining provinces have smaller RCM values compared to declining provinces. Hence, growing population seems to display greater structural issues than the declining provinces. Therefore, regional policies should be implemented in provinces with negative RCM, especially in those that are not in decline, to enhance this age group's situation.

2.5.3.2.2 Competition effect (neighbourhood and regional context)

The competitive neighbourhood effect (NCE) determines whether a given age cohort in the province under analysis is relatively weak or strong compared to its neighbors, as illustrated in Table 2.2. If the competitive effect is negative, political recommendations should target sectoral regional and interterritorial policies aimed at improving a given age cohort and reversing the competitive effect of the neighbouring province.

For the population under 16 years, as shown in Figure 2.8, growing provinces are more competitive compared to their neighbors (in the upper part of Figure 2.8). In contrast, declining provinces show a negative competitive neighbourhood effect in most of the provinces. The one-way ANOVA (Table 2.6) confirms that the differences are significant. Therefore, the analysis of data confirms that provinces in decline should implement sectoral regional and interterritorial policies aimed at improving the under-16 population and reversing the greater competitiveness of neighbouring provinces.

Regarding the second component, the regional neighbourhood effect (RNE) in the population under 16 years of age is weak and negative in the declining provinces. The one-way ANOVA confirms significant mean differences in this demographic component. Consequently, declining provinces should implement regional and interregional policies to improve the total population over their neighbouring provinces.

Figure 2.8 Spatial shift-share components (population less than 16)

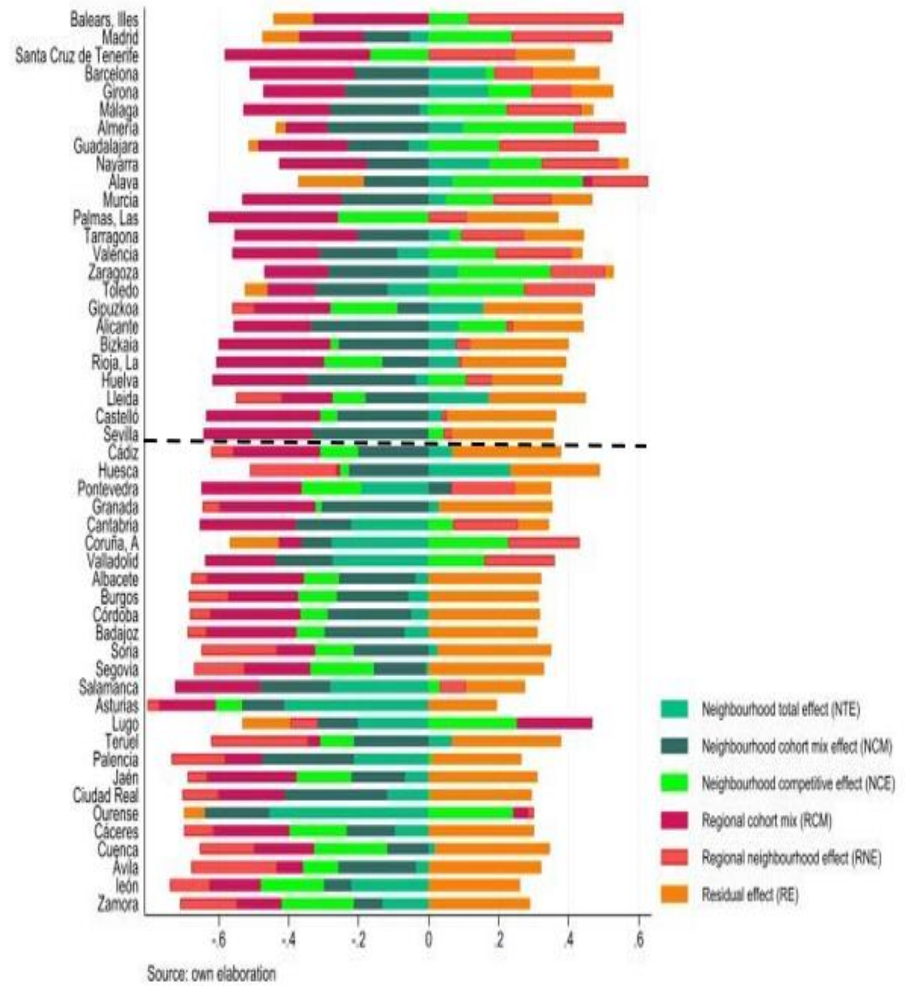


Table 2.6 One Way Anova: population less than 16
(two groups: provinces with non-declining population, provinces with declining population)

	F statistic	Bartlett's equal variances (CHI2)	Bonferroni comparison (non-declining-declining)
NCM	0.98 (0.3269)	0.760 (0.383)	-0.025
RCM	10.13*** (0.0026)	1.397*** (0.0026)	-0.096
NCE	7.09** (0.0105)	1.041 (0.308)	0.118
RNE	24.72*** (0.0000)	0.129 (0.720)	0 .189

P-Value in brackets

Source: Own elaboration

2.5.3.3 Population between 16 and 64

2.5.3.3.1 Cohort mix effect (neighbourhood and regional context)

Figure 2.9 illustrates the demographic components' weight for the population aged 16-64, revealing a negative NCM for all provinces. However, the one-way ANOVA (Table 2.8) suggests that there are no significant differences in the NCM between the two groups of provinces. Age-group specific inter-territorial policies should be implemented to improve the population dynamics between 16 and 64 years old and prevent backward effects among neighbors. These cross-sectoral policies should be applied to all provinces.

Regarding the population aged 16-64, Figure 9 shows a similar pattern to that of the population under 16. The RCM is negative in most provinces, and the one-way ANOVA (Table 2.7) indicates no differences between groups concerning the RCM component. Therefore, regional policies should be implemented to improve this age group.

2.5.3.3.2 Competitive effect (neighbourhood and regional context)

Figure 2.9 shows that the competitive neighbourhood effect (NCE) for the population aged 16-64 is positive in growing provinces, while declining provinces show a negative effect. The one-way ANOVA (Table 2.8) confirms that there are significant differences between non-declining and declining provinces. To reverse this situation, declining provinces should implement sectoral regional and interterritorial policies aimed at enhancing the population in this age cohort and reversing the competitive neighbourhood effect.

Similar to the population under 16, the regional neighbourhood component (RNE) for the population between 16 and 64 is also negative in declining provinces. However, the one-way ANOVA (Table 2.7) indicates that there are no significant differences on average terms in this demographic component between non-declining and declining provinces. In growing provinces, RNE is positive, and together with NCE, it seems to be the driving force for population growth. Declining provinces should apply regional and interregional policies to improve the total population over their neighbouring provinces.

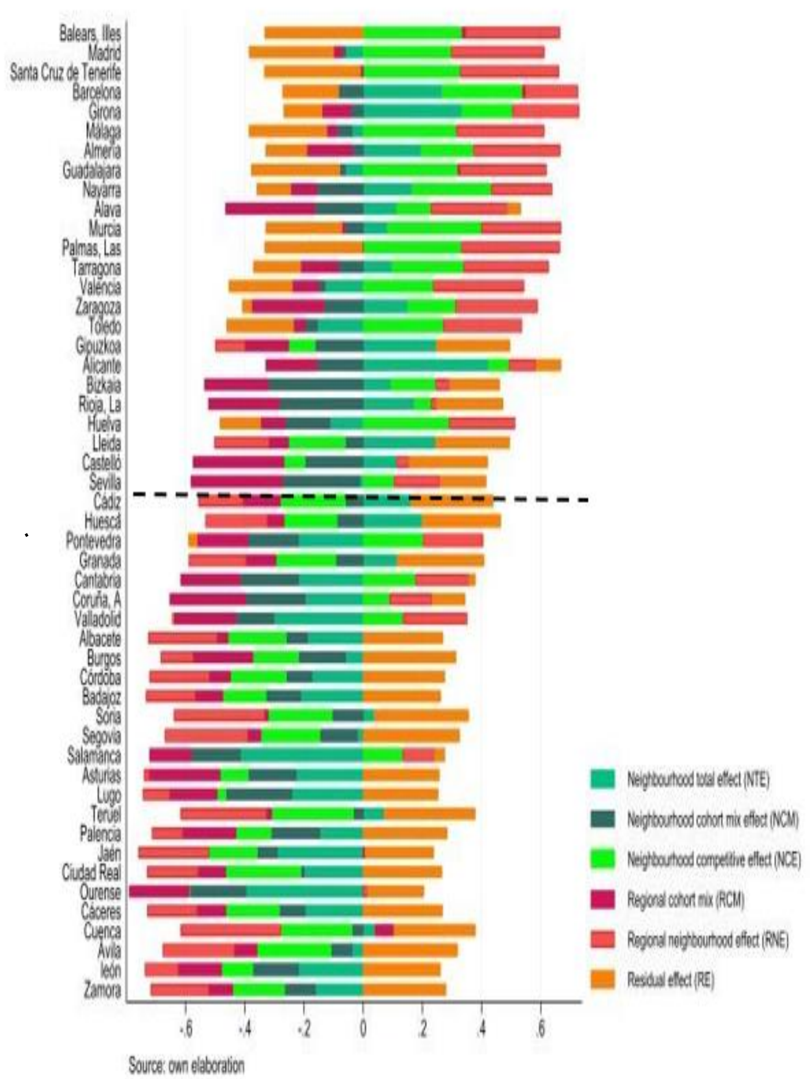
Table 2.7 One Way Anova: population between 16 and 64 years (two groups: provinces with non-declining population, provinces with declining population)

	F statistic	Bartlett's equal variances (CHI2)	Bonferroni comparison (non-declining-declining)
NCM	0.81 (0.3713)	5.290** (0.021)	0.019
RCM	0.01 (0.9295)	1.301 (0.254)	-0.0024
NCE	39.62*** (0.0000)	0.399 (0.527)	0.276
RNE	42.04*** (0.0000)	0.129 (0.719)	0.298

P-Value in brackets

Source: Own elaboration

Figure 2.9 Spatial shift-share components (population between 16 and 64)

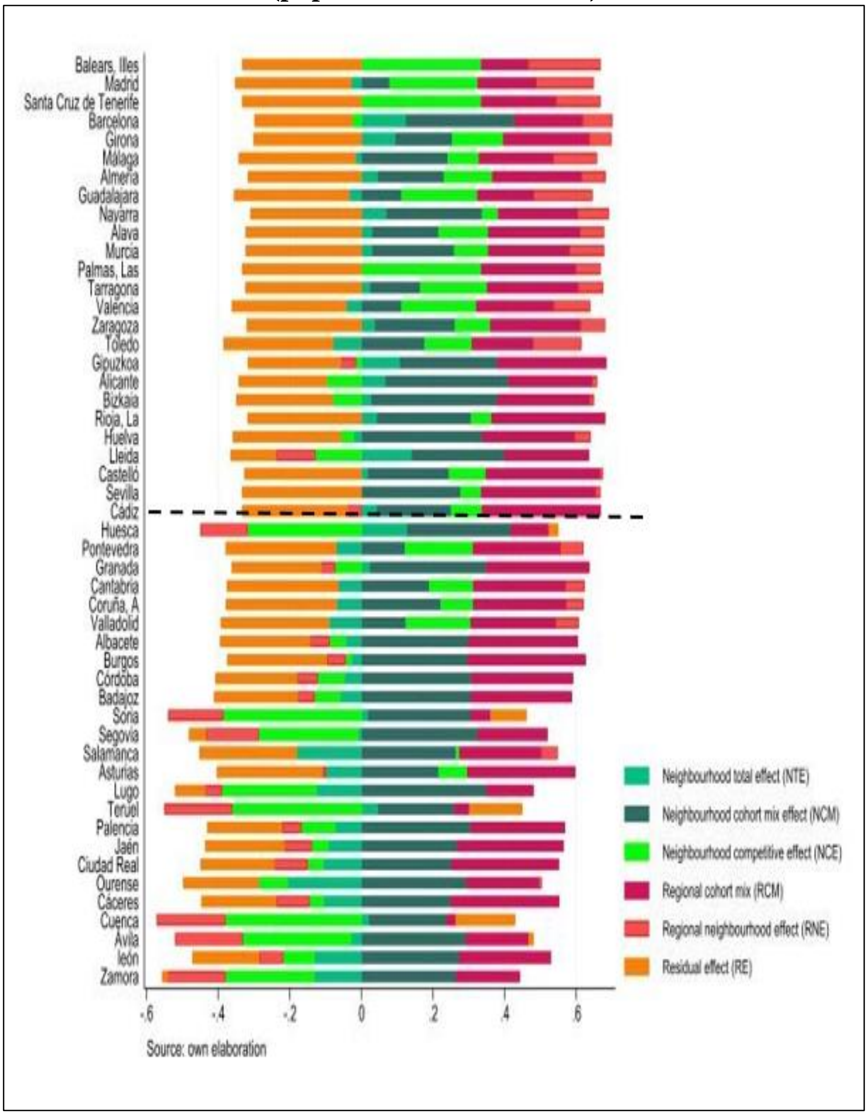


2.5.3.4 Population more than 65

2.5.3.4.1 Cohort mix effect (neighbourhood and regional context)

Figure 2.10 shows that the neighbourhood population mix (NCM) for the 65+ age cohort is positive in all provinces, with the NCM being the main driver of population growth in most of them. One-way ANOVA (Table 2.9) confirms that there are significant differences in the NCM effect, which contributes greatly to population growth in declining provinces.

Figure 2.10 Spatial shift-share components.
(population more than 65)



When examining the regional population mix (RCM) component, it becomes clear that the 65+ age cohort displays a distinct pattern compared to the younger cohorts, as can be seen in Figure 2.10. Notably, this age group has a positive effect in all provinces. However, Bartlett's Test suggests that the variances between the declining and growing provinces are not equal. Therefore, relying solely on one-way ANOVA (Table 2.8) is not enough to draw conclusive results. Nevertheless, the findings do suggest that this age cohort presents advantages relative to the other age groups.

2.5.3.4.2 Competitive effect (neighbourhood and regional context)

The analysis of the competitive effect (NCE) reveals a negative value for declining provinces, which indicates that it is a significant driver of population change in these regions. This effect is particularly evident in certain provinces where it contributes to population decline. To counteract this trend and reverse the competitive effect of neighbouring provinces, it is recommended to implement sectoral policies aimed at improving the well-being of the 65+ population.

The results of one-way ANOVA (Table 2.8) confirm that there is a significant difference in the average NCE between non-declining and declining provinces. This further emphasizes the need for tailored policies that take into account the specific challenges faced by declining regions in order to promote sustainable growth and development.

Table 2.8 One Way Anova: population more than 65 years (two groups: provinces with non-declining population, provinces with declining population)

	F statistic	Bartlett's equal variances (CHI2)	Bonferroni comparison (non-declining-declining)
NCM	7.18** (0.0101)	7.578*** (0.006)	-0.063
RCM	0.67 (0.4170)	5.782** (0.016)	0.017
NCE	23.17*** (0.0000)	1.940 (0.164)	0.207
RNE	33.99*** (0.0000)	0.492 (0.483)	0.127

P-Value in brackets

Source: Own elaboration

The regional neighbourhood effect (RNE) is negative in declining provinces, particularly for older people, as confirmed by the one-way ANOVA (Table 2.9), which shows a significant difference in average terms for this demographic component.

To address this issue, declining provinces should consider implementing regional and interregional policies that aim to improve the overall well-being of their population aged 65 and above relative to that of their neighbouring provinces. These policies could focus on various factors, such as improving healthcare access and infrastructure, promoting employment opportunities, and enhancing educational and recreational opportunities for older residents. By working to reverse the negative impact of the RNE on their older population, declining provinces can help promote sustainable growth and development and improve the quality of life for their residents.

2.6.- Joint Analysis

The joint analysis is presented for each of the age cohorts under consideration, taking into account the two studied effects: cohort composition and regional/provincial impact. Each effect has been thoroughly examined through conditional maps that incorporate regional, neighbourhood, and national perspectives. The horizontal axes represent the regional context, while the vertical axes depict the neighbourhood context, with the national context visually represented by color-coding.

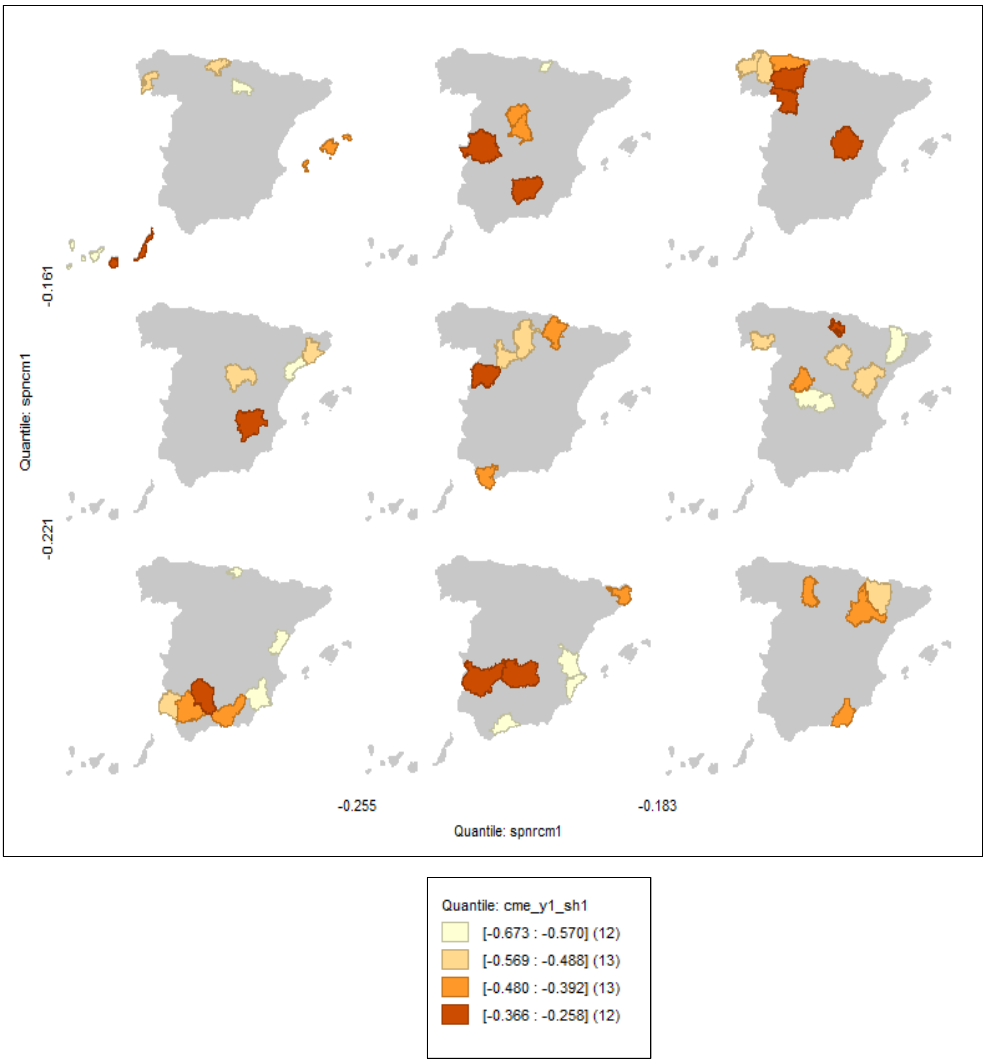
Figure 2.11 indicate the cohort mix effect corresponding to population less than 16, CME, NCM and RCM (national, neighbourhood and competitive effect). Provinces have been classified according to the quartiles of demographic components. In the lower left corner are located the provinces with the smaller cohort mix effect (regional and neighbourhood context) and in light color are the provinces with less national cohort mix effect advantage. According to the map 2.11, Vizcaya, Castellon and Murcia are the provinces worse situated in cohort effect in population less than 16. The best situated are Cuenca, Leon and Zamora. As it has been studied in previous sections, population less than 16, present in all Spanish provinces problems in cohort mix effects, thus it would be necessary to fit policies addressed to fix young people at provinces, especially in those with high disadvantages (Figure 2.11).

Map 2.12 denote the cohort mix effect corresponding to population between 16 and 65 in the national, neighbourhood and regional context. The worst provinces are la Rioja and Sevilla and the best situated in the three contexts of cohort mix effect are Baleares, Jaen, Madrid, Cuenca, and Teruel.

In Figure 2.13, in the three contexts. The provinces with the highest advantage are Granada, Burgos and Sevilla. Cuenca y Teruel is in the opposite side in the three contexts.

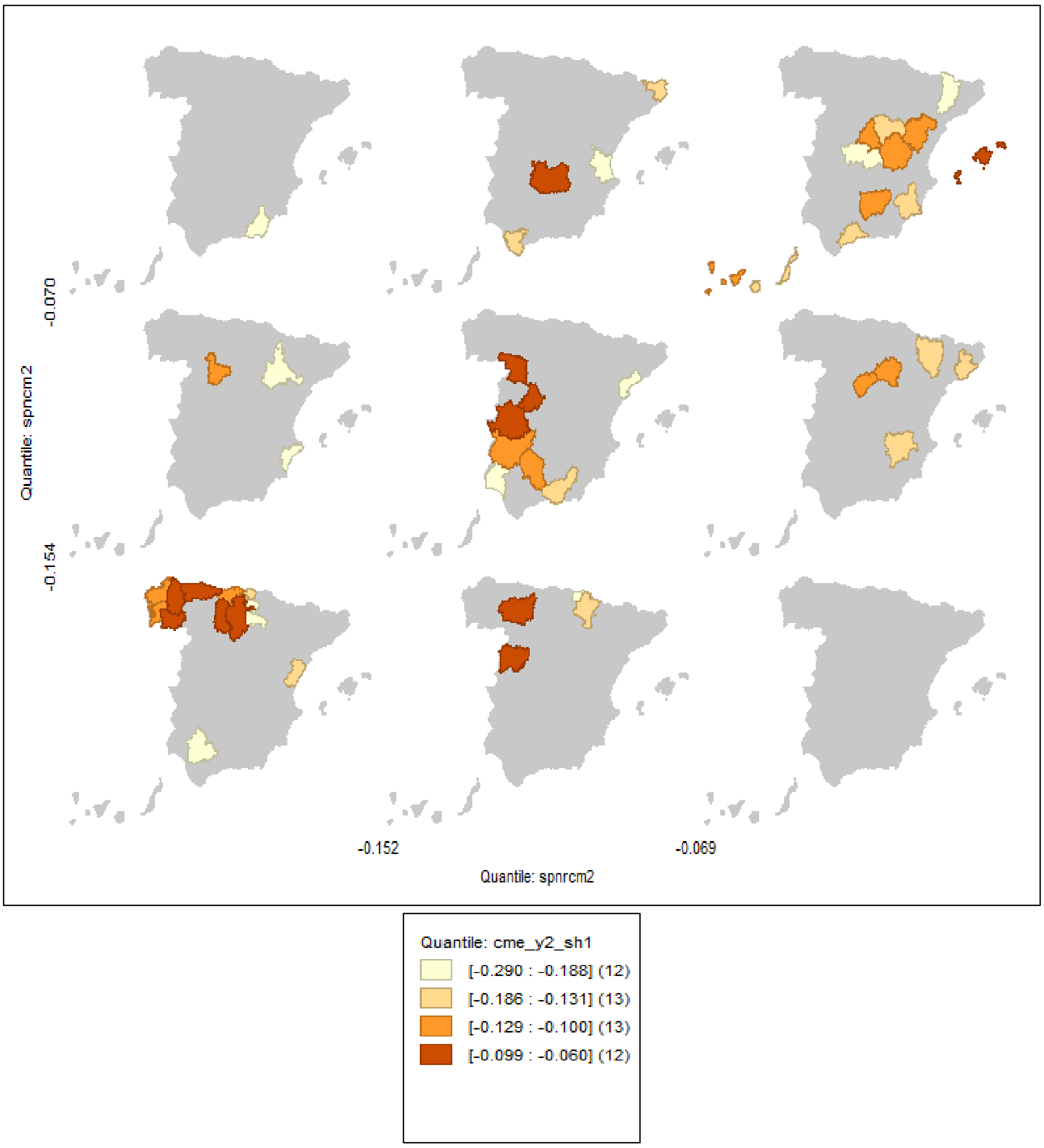
Madrid, Valencia and Toledo present a high cohort national effect but in terms of neighbourhood and regional context the cohort effect is low.

Figure 2.11 Population less than 16. Cohort mix effect in the three contexts. (national, neighbourhood and regional).



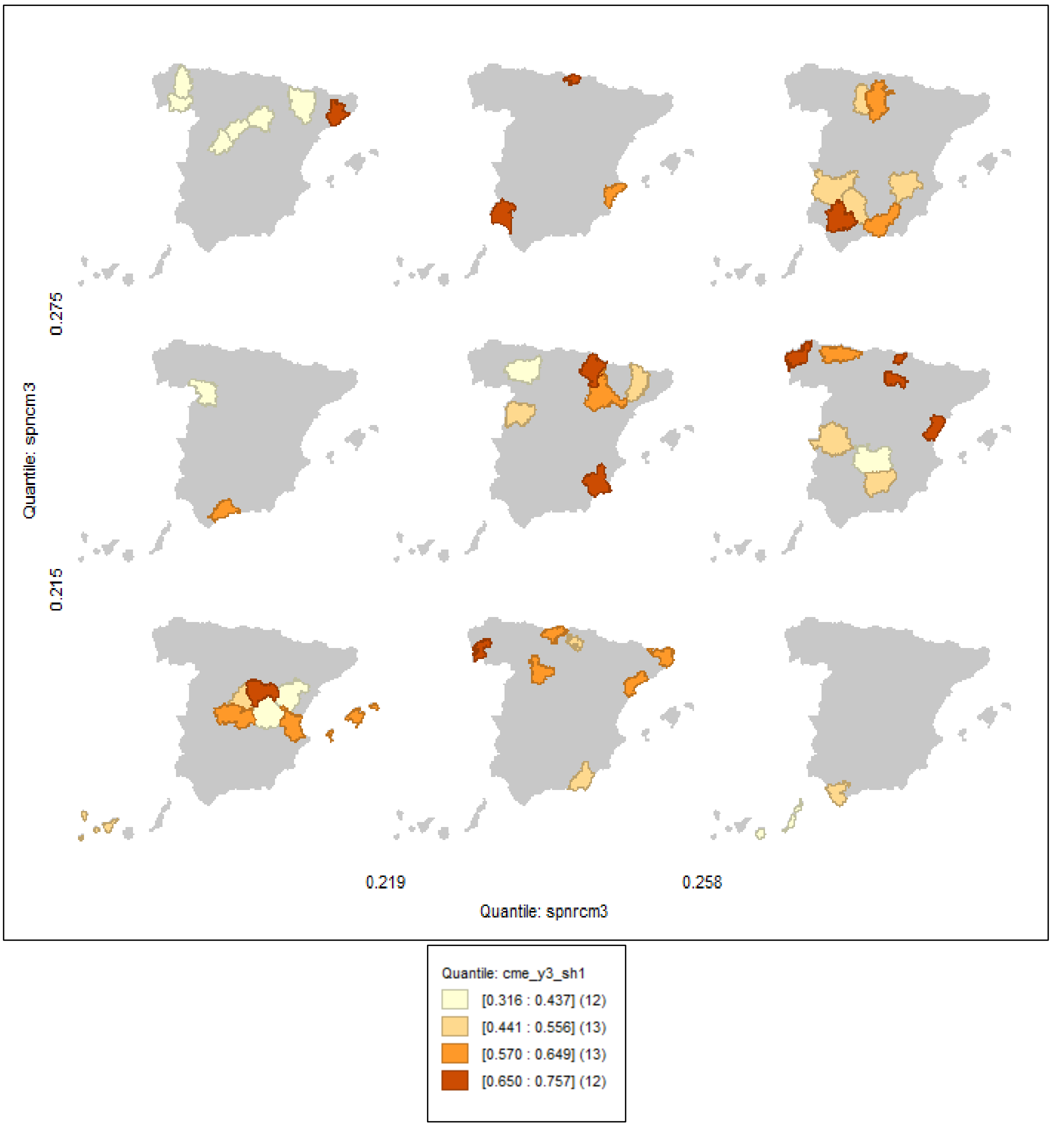
Source: Own elaboration

Figure 2.12 Population between 16 and 64. Cohort mix effect in the three contexts. (national, neighbourhood and regional).



Source: Own elaboration

Figure 2.13 Population more than 65. Cohort mix effect in the three contexts.
(national, neighbourhood and regional).



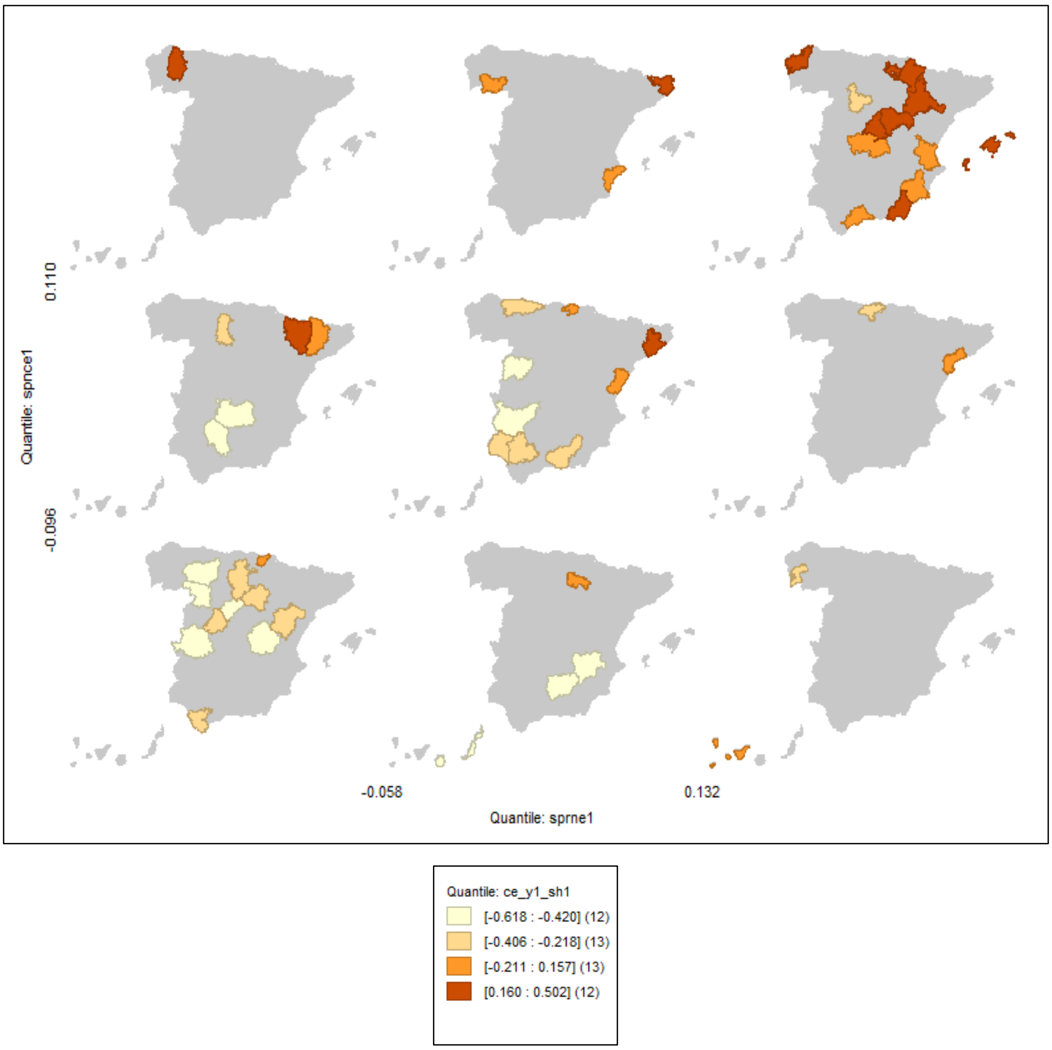
Source: Own elaboration

In a similar way, in Figures 2.14, 2.15 and 2.16 are represented the three-cohort group attending to regional/provincial effect, joining the three contexts (national, neighbourhood and regional). Population less than 16, in Figure 2.14, indicates that the provinces with highest effects in the three contexts are: Baleares, Guadalajara, Navarra, Madrid, Zaragoza, Almeria and La Coruña. The regional effect on these provinces is the driver and the source of population growth. The worst are Cáceres, Cuenca, León, Segovia and Zamora. In this case, policies should be addressed at regional level. Competition in this case is the same age cohort but at a different administrative level (national and neighbourhood)

Figure 2.16 is represented the regional effect corresponding to population between 16 and 64. The provinces with high advantages in the three contexts are: Tarragona Baleares, Murcia, Guadalajara, Navarra, Malaga, Girona, Almeria, and Madrid. The ones with more disadvantages are Caceres, Ciudad Real, Zamora and Avila.

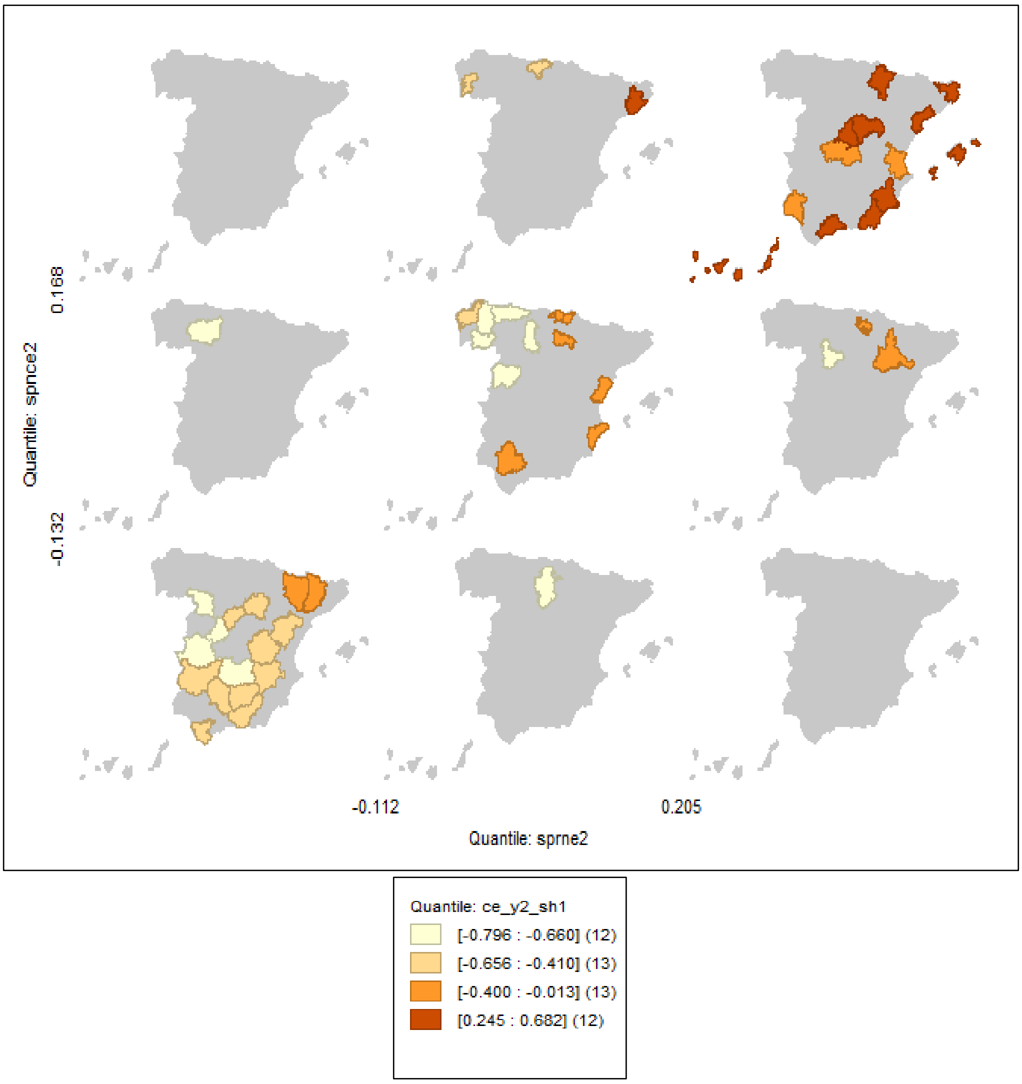
In Figure 2.16 are the oldest age group, the province with more advantages in the three contexts are: Tarragona, Baleares, Valladolid, Madrid, Almeria, and Alava. The province with less advantages: Cuenca, León, Zamora, Soria, Avila, Teruel, Huesca, and Lugo.

Figure 2.14 Population less than 16. Competitive effect in the three contexts (national, neighbourhood and regional).



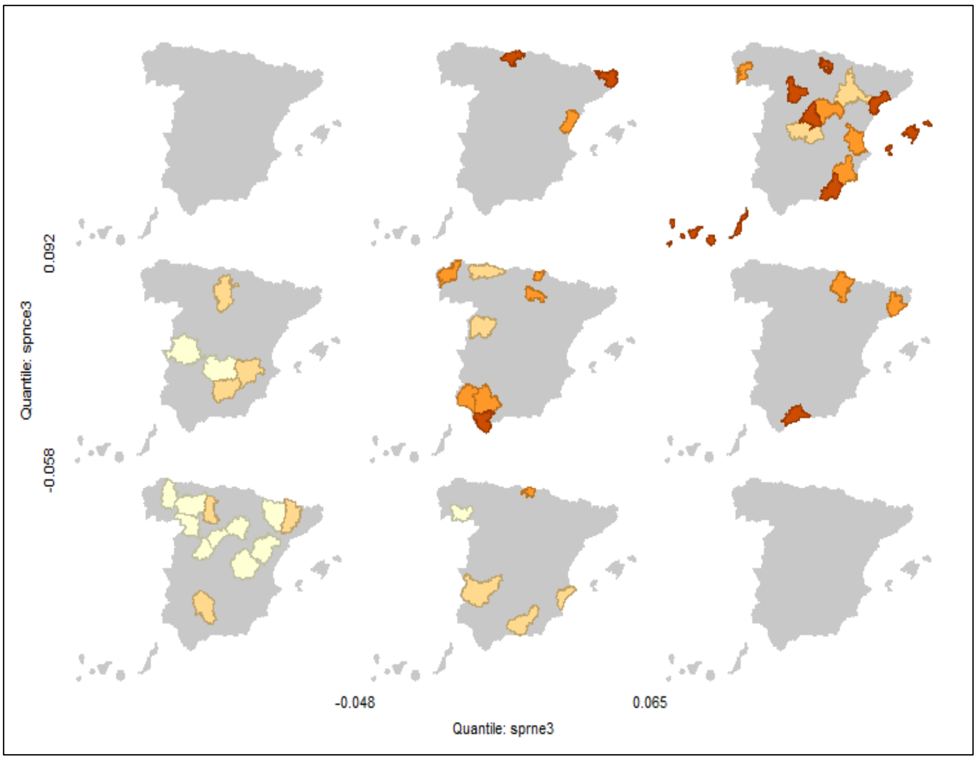
Source: Own elaboration

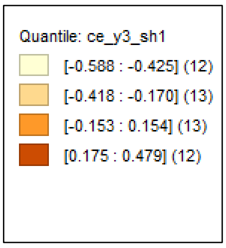
Figure 2.15 Population between 16 and 64. Competitive effect in the three contexts. (national, neighbourhood and regional).



Source: Own elaboration

Figure 2.16 Population more than 65. Competitive effect in the three contexts (national, neighbourhood and regional).





Source: Own elaboration

2.7.- Conclusion: National Context and Spatial context

On this section we present a summarize of results obtained and the main conclusions. In order to follows the same structure, first we present the summary and conclusion for the national context and subsequently, we replicate this approach for the neighbouring context.

According with the study, population less than 16 (Figure 2.5) and between 16 and 64 (Figure 2.6) show disadvantages in **cohort mix effects (CME).** The negative sign in CME denotes that there are structural problems in these age cohorts at national level. Therefore, the policy recommendation will be directed towards improving the situation of these age cohorts **(national policy**).

The following are examples of specific economic policy measures and recommendations aimed at increasing the population of children under the age of 16. A recommendation should be to increase access to affordable childcare. This measure would allow parents to have more children without risking sacrificing their careers or financial stability. Governments could subsidize the cost of childcare or provide tax incentives to companies that offer it (Zhou and Guo, 2020). Another proposal could be to improve parental leave policies. Governments could offer longer and better-paid parental leave policies to encourage childbearing (Tamm, 2019). To provide financial incentives for families with children and tax breaks, grants, or other financial incentives to families with children would be another suggestion (Raute, 2019).

In relation to the population between the ages of 16 and 64, there are several measures and policy recommendations that could be considered. Among others, to increase access to affordable housing. Housing is often a major expense for individuals and families and can be a significant barrier to having children. Governments could subsidize the cost of housing or provide tax incentives for developers to build more affordable housing (Florida, Mellander and King, 2021). It is also necessary to improve access to education and job training, as they are key factors for enhancing employment prospects and the income potential of individuals. Governments could invest in education and job training programs to assist people in advancing their careers and feeling more financially secure (Brunello and Wruuck, 2021). To support the private sector, tax incentives could be offered to companies that hire and retain employees: Many companies struggle to attract and retain talented employees, particularly those in high-demand fields. Governments could offer tax breaks to companies that hire and retain employees, particularly those in the 16-64 age range (Booth and Snower, 1996; Filippetti, Guy and Iammarino, 2019; Salaghe, Watson, Hildebrandt and Landis, 2020; Rossi, Baines and Smith, 2023). Another public policy could be to improve access to healthcare because is essential for individuals to maintain their health and well-being. Governments could invest in healthcare infrastructure and expand access to health insurance to improve overall health outcomes and increase the population between 16 and 64 (Kara, Tas and Ada, 2016; Pereira, Pereira and Rodrigues, 2019). Finally, demographic, and cultural factors that discourage childbearing could be addressed. In some cultures, there may be a stigma associated with having children or a belief that it is not financially feasible. Governments could LAU-2nch public awareness campaigns to address these beliefs and promote the benefits of having children (De Beer and Deerenberg, 2007; Gauthier, 2007; Kulu, 2013; Campisi et al. 2020).

About population more than 65 denote cohort advantages (CME>0) in all provinces. This is the cohort that performs best with respect to global change.

As for the **competitive effect (CE),** our results reveal a positive trend in growing provinces and a negative trend in declining provinces in all age groups. The results underline the fundamental role of the competitive effect (CE) as a determinant of provincial demographic change, which exerts a variable influence on the different age groups depending on the growth situation of the province.

A positive sign in the CE underlines its role as a driver of population growth in all age segments. Conversely, in declining provinces, a negative CE implies a loss of competitiveness, which translates into a slowdown in population growth. In such circumstances, it becomes imperative for provinces to deepen **regional policies** specifically focused on boosting the development of certain age groups. Therefore, policymakers should focus on improving the CE in declining provinces to attract new residents, thereby increasing their competitiveness, and driving population growth.

Concerning to the **spatial shift-share**, we provide a concise summary of demographic components obtained in section 2.5.3 and referred to the three age-group considered. We addressed to the two context, neighbourhood context and regional context, and in each context the corresponding effects (figures 2.8, 2.9 and 2.10):

- Neighbourhood context: Cohort Mix Effect (NCM) and Competitive effect (NCE)
- Regional context: Cohort Mix Effect (RCM) and Competitive effect (RCE)

In relation to **cohort mix effects (neighbourhood cohort mix, NCM, and regional cohort mix, RCM),** the population under 16 and the 16 to 64 age groups exhibit consistent disadvantages across all provinces. Consequently, the findings underscore that these particular age groups face inherent structural challenges. This underscores the necessity for a comprehensive examination of the geographical context and the promotion of targeted inter-territorial and regional policy recommendations tailored to address the unique needs of each age cohort (referred to as inter-territorial and regional policies). Population more than 65 presents positive contribution in cohort mix effects in all provinces.

The **competitive effect**, which encompasses both the **neighbourhood competitive effect (NCE) and the regional competitive effect (RCE)**, shows a positive trend in all age groups within the provinces experiencing growth. On the contrary, in the provinces in demographic decline, these effects are negative in all age groups. In the latter case, where competitive effects with neighbouring provinces are adverse, addressing these challenges requires specific local or regional policies tailored to particular age groups (so-called sectoral competitive policies). Besides, it is imperative to develop policies aimed at stimulating overall population growth by implementing regional competitive policies.

Table 2.9 provides a concise presentation of our comprehensive analysis, outlining the results obtained from both the national and spatial context in terms of the demographic components obtained through the shift-share methodology. In addition, it highlights the sign of the demographic components: those with a negative sign, marked in red, represent factors that decrease the overall growth potential of demographic change.

Table 2.9 Demographic components on National and Spatial Shift-Share

		National context		Neighbourhood context		Regional context	
	Sign of population change	**Cohort Mix Effect (CME) (Structural national policy)**	**Competitive effect (CE) (Regional and national policy)**	**Cohort Mix Effect (NCM) (Interterritorial policy)**	**Competitive effect (NCE) (Regional and interterritorial policy)**	**Cohort Mix Effect (RCM) (Interterritorial policy)**	**Regional neighbourhood effect (RNE) (Regional and interterritorial policy)**
Growing provinces	Less 16 years	Structural factor negative (higher)	Competition factor positive	Negative Structural effect (higher)	Positive Competitive effect (higher)	Negative Structural effect (higher)	Positive competitive effect (higher)
	Between 16 and 64	Structural factor negative (higher)	Competition factor positive	Negative Structural effect	Positive Competitive effect (higher)	Negative Structural effect (higher)	Positive competitive effect (higher)
	More than 65	Structural factor positive (higher)	Competition factor positive	Positive Structural effect	Positive Competitive effect (higher)	Positive structural effect (higher)	Positive competitive effect (higher)
Declining provinces	Less 16 years	Structural factor negative	Competition factor negative	Negative Structural effect	Negative Competitive effect	Negative Structural effect	Negative competitive effect
	Between 16 and 64	Structural factor negative	Competition factor negative	Negative Structural effect (higher)	Negative Competitive effect	Negative Structural effect	Negative competitive effect
	More than 65	Structural factor positive	Competition factor negative	Positive Structural effect (higher)	Negative Competitive effect	Positive structural effect	Negative competitive effect

Source: own elaboration

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Annex A: Classical Shift-Effect

Table 2.10 Classical Shift-share (2015-2020)

		POPULATION MORE THAN 65				POPULATION BETWEEN 16 AND 64				POPULATION LESS THAN 16			
Province	Pop growth (%)	National Effect	Structural Cohort effect	Competitive Effect	Total effect	National effect	Structural cohort effect	Competitive Effect	Total effect	National effect	Structural Cohort effect	Competitive effect	Total effect
Álava	3.2	1097.9	3624.0	2602.1	7324	3651.5	-1620.0	-938.6	1193	877.1	-1838.0	2735.9	1775
Albacete	-1.6	1267.7	4184.6	-2993.3	2459	4499.3	-1872.8	-7113.5	-4487	1092.6	-2289.7	-3085.0	-4282
Alicante	1.3	6162.0	20340.6	-7951.5	18551	20949.2	-8720.1	-1622.1	10607	5137.9	-10766.9	1311.9	-4317
Almería	3.4	1701.8	5617.5	3137.8	10457	8267.2	-3441.2	6165.0	10981	2221.3	-4654.9	4624.6	2191
Ávila	-4.4	721.2	2380.6	-3453.8	-352	1774.2	-738.5	-6749.7	-5714	371.8	-779.0	-787.7	-1195
Badajoz	-2.1	2210.5	7296.7	-5139.2	4368	7798.8	-3246.3	-16440.6	-11888	1885.3	-3950.7	-4972.6	-7038
Balears, Illes	6.1	2896.1	9560.1	4175.8	16632	13133.2	-5466.7	39936.5	47603	3171.5	-6646.2	6303.6	2829
Barcelona	4.0	17571.2	58002.2	1029.6	76603	62577.7	-26048.0	109555.2	146085	16882.0	-33281.6	14191.7	-3208
Burgos	-1.7	1414.2	4668.2	-1641.4	4441	4029.1	-1677.1	-11226.0	-8874	884.7	-1854.0	-949.7	-1919
Cáceres	-3.8	1643.1	5093.7	-4909.8	1727	4514.9	-1879.3	-14972.6	-12337	957.4	-2006.3	-3493.1	-4542
Cádiz	0.1	3259.2	10758.6	7467.2	21485	14477.9	-6026.4	-17231.5	-8780	3824.6	-8014.7	-7550.9	-11741
Castelló	0.6	1828.5	6035.8	269.8	8134	6639.2	-2763.6	-6007.7	-2132	1655.8	-3469.8	-925.0	-2739
Ciudad Real	-3.6	1719.1	5674.6	-5581.6	1812	5827.5	-2425.7	-18590.8	-16189	1384.1	-2900.5	-3774.6	-5291

Córdoba	-2.1	2547.4	8409.0	-5521.4	5435	9031.5	-3759.4	-18285.2	-13013	2252.4	-4720.0	-6641.4	-9109
Coruña, A	-0.5	4545.4	16004.2	-3538.5	16011	12446.4	-5180.8	-27231.6	-19966	2512.7	-5265.6	1483.9	-1269
Cuenca	-3.8	818.4	2701.4	-5024.8	-1605	2234.4	-930.1	-5126.3	-3822	490.9	-1028.8	-1837.2	-2375
Girona	3.8	2228.4	7355.8	2674.8	12259	8573.7	-3568.8	10534.1	16539	2289.4	-4797.6	3444.2	936
Granada	-0.3	2730.3	9012.8	-3744.1	7999	10535.1	-4385.2	-10378.9	-4229	2631.1	-5513.6	-3729.5	-6612
Guadalajara	3.3	685.0	2261.3	-111.3	2835	2931.9	-1220.4	3964.5	5676	793.3	-1662.4	667.1	-202
Gipuzkoa	1.4	2618.0	8641.8	1367.2	12627	7898.1	-3287.6	-4784.5	-174	1945.8	-4077.6	-34.2	-2166
Huelva	0.6	1431.0	4723.6	-419.5	5735	6069.9	-2526.6	-3038.3	505	1639.4	-3226.0	-1645.5	-3232
Huesca	-0.1	856.1	2825.9	-2970.0	712	2458.9	-1023.5	-2317.4	-882	560.2	-1173.9	561.7	-52
Jaén	-3.5	2100.0	6932.1	-5934.1	3098	7455.0	-3103.2	-19138.9	-14787	1817.4	-3808.5	-9108.9	-11100
León	-4.8	2146.7	7086.4	-7611.1	1622	5228.1	-2176.2	-23847.9	-20796	959.2	-2010.1	-2731.1	-3782
Lleida	0.6	1414.9	4670.5	-2311.4	3774	4931.6	-2052.8	-3119.8	-241	1233.7	-2585.3	306.6	-1045
Rioja, La	0.9	1094.4	3612.6	-339.0	4368	3545.7	-1475.9	-2558.8	-489	871.7	-1826.8	-63.0	-1018
Lugo	-3.4	1686.4	5566.8	-8040.2	-787	3594.4	-1496.2	-12472.3	-10374	619.2	-1297.6	399.4	-279
Madrid	5.3	18773.8	61971.9	48080.3	128826	74492.6	-31007.5	168407.9	201893	18637.8	-39056.7	32591.9	12173
Málaga	3.4	4644.9	16332.8	6941.3	26919	18734.6	-7798.3	21217.7	32164	4881.4	-10229.3	2206.9	-3141
Murcia	3.0	3818.2	12603.9	1910.8	18333	16887.3	-7029.3	18256.0	28114	4802.6	-10064.1	2777.5	-2484
Navarra	3.2	2107.6	6957.3	346.1	9411	7166.7	-2983.1	5860.5	10044	1860.1	-3897.9	3303.8	1266

Ourense	-3.7	1679.6	5544.2	-7165.8	68	3276.6	-1363.9	-12608.7	-10696	578.9	-1213.1	-478.8	-1113
Asturias	-3.1	4395.0	14507.9	-5147.9	13755	11746.6	-4889.5	-47907.1	-41050	2133.5	-4470.9	-2812.6	-5160
Palencia	-3.4	692.6	2286.3	-1610.9	1468	1846.0	-768.4	-7377.6	-6300	347.8	-728.9	-501.0	-882
Palmas, Las	3.0	2629.7	8680.5	10402.8	21713	13473.9	-5608.5	16003.6	22869	2991.7	-6269.2	-8645.4	-11923
Pontevedra	-0.2	3425.0	11305.8	2029.3	16760	10634.6	-4426.7	-19368.0	-13160	2303.0	-4826.1	-2579.9	-5103
Salamanca	-3.0	1603.3	4962.3	-4640.6	1825	3653.2	-1620.6	-11339.5	-9207	743.8	-1658.7	-1953.1	-2768
Santa Cruz de Tenerife	4.3	2771.0	9147.2	6348.8	18267	12028.0	-5006.7	21878.7	28900	2587.4	-5422.0	-1448.4	-4283
Cantabria	-0.4	2062.1	6806.8	1942.2	10811	6643.9	-2765.5	-14090.4	-10212	1467.2	-3074.5	-1265.7	-2873
Segovia	-2.6	602.6	1989.3	-2377.9	214	1744.2	-726.0	-4013.2	-2995	392.5	-822.5	-881.0	-1311
Sevilla	0.3	5220.2	17231.7	3361.2	25813	22389.0	-9319.4	-17969.6	-4900	6142.6	-12872.2	-7787.4	-14517
Soria	-2.3	400.8	1322.9	-2041.7	-318	973.3	-405.1	-1933.2	-1365	208.0	-436.0	-211.1	-439
Tarragona	2.7	2442.4	8062.4	3503.2	14008	8905.0	-3706.7	4091.7	9290	2373.5	-4973.8	856.3	-1744
Teruel	-3.4	572.8	1890.8	-3263.5	-800	1607.5	-627.5	-4069.0	-3189	334.9	-701.9	-400.0	-767
Toledo	1.5	2073.2	6843.6	-1829.8	7087	7856.5	-3270.3	-148.2	4438	2124.2	-4451.5	1203.2	-1124
Valencia	1.9	7913.6	26122.7	6191.7	40228	29141.4	-12130.1	-1166.3	16845	7169.4	-16003.0	330.6	-7513
Valladolid	-1.1	1935.1	6387.9	1769.0	10092	5902.8	-2457.1	-16253.8	-12808	1311.3	-2747.9	-1486.4	-2923
Bizkaia	0.9	4323.0	14270.3	-1636.4	16957	12808.5	-5331.5	-11170.9	-3694	2831.9	-5934.4	537.5	-2565

Zamora	-7.0	948.4	3130.8	-5585.2	-1606	1911.2	-795.5	-10561.7	-9446	329.3	-690.1	-1635.2	-1896
Zaragoza	1.7	3381.8	11163.3	-3125.1	11420	10668.3	-4440.7	-1692.7	4535	2521.0	-5283.0	3376.9	615

Source: own elaboration

Annex B: Spatial shift-share effect. Population less than 16

Table 2.11 Spatial shift-share effect (2015-2020)

POPULATION LESS THAN 16								
Province	Pop growth (%)	Total effect (TE)	Neighbourhood total effect (NTE)	Neighbourhood Cohort Mix (NCM)	Neighbourhood Competitive Effect (NCE)	Regional Cohort Mix (RCM)	Regional Neighbourhood effect (RNE)	Residual effect (RE)
Álava	3.18	1775.00	480.22	-1300.29	2595.08	170.66	1124.12	-1294.78
Albacete	-1.60	-4282.00	-445.53	-2627.50	-1208.97	-3276.92	-559.54	3836.47
Alicante	1.34	-4317.00	3257.27	-12652.20	5077.94	-8274.67	700.40	7574.27
Almería	3.37	2191.00	1716.62	-5081.19	5556.56	-2114.65	2590.03	-475.38
Ávila	-4.40	-1195.00	-127.84	-734.06	-333.10	-253.55	-813.62	1067.17
Badajoz	-2.13	-7038.00	-1279.31	-4251.67	-1607.02	-4730.58	-1028.10	5758.69
Balears, Illes	6.07	2829.00	0.00	0.00	2829.00	-8248.46	11077.46	-2829.00
Barcelona	3.97	-3208.00	21673.40	-27883.20	3001.75	-39506.50	14625.06	24881.40
Burgos	-1.75	-1919.00	-306.38	-1045.43	-567.19	-1030.91	-581.71	1612.62
Cáceres	-3.75	-4542.00	-1104.34	-1676.02	-1861.65	-2474.14	-963.52	3437.66
Cádiz	0.08	-11741.00	3188.92	-9698.80	-5231.13	-11912.00	-3017.93	14929.92
Castelló	0.56	-2739.00	386.37	-2634.97	-490.39	-3272.69	147.33	3125.37

Ciudad Real	-3.63	-5291.00	-1637.46	-3807.72	54.18	-2397.73	-1355.80	3753.54
Córdoba	-2.10	-9109.00	-1249.43	-5951.93	-1907.64	-6391.57	-1468.00	7859.57
Coruña, A	-0.47	-1269.00	-2551.46	-798.47	2080.94	-596.00	1878.46	-1282.46
Cuenca	-3.78	-2375.00	135.36	-921.68	-1688.68	-1307.97	-1202.39	2510.36
Girona	3.82	936.00	2991.98	-4192.81	2136.83	-4088.96	2032.98	2055.98
Granada	-0.31	-6612.00	662.48	-6909.10	-365.39	-6141.61	-1132.87	7274.48
Guadalajara	3.28	-202.00	-385.22	-1169.19	1342.41	-1696.59	1879.81	-183.22
Gipuzkoa	1.44	-2166.00	2741.06	-1674.45	-3332.61	-3772.23	-1134.83	4907.06
Huelva	0.58	-3232.00	-507.86	-4195.76	1471.62	-3744.22	1020.08	2724.14
Huesca	-0.10	-52.00	595.52	-581.04	-66.48	-19.91	-627.61	647.52
Jaén	-3.48	-11100.00	-1997.09	-4499.65	-4603.26	-7458.12	-1644.79	9102.91
León	-4.79	-3782.00	-1738.07	-628.08	-1416.85	-1139.88	-904.05	2043.93
Lleida	0.57	-1045.00	1725.69	-1818.67	-952.03	-1449.94	-1320.76	2770.69
Rioja, La	0.90	-1018.00	408.86	-640.88	-785.98	-1470.49	43.63	1426.86
Lugo	-3.37	-279.00	-868.24	-494.07	1083.31	921.64	-332.41	-589.24
Madrid	5.33	12173.00	-12870.70	-32517.30	57560.96	-44936.20	69979.91	-25043.70
Málaga	3.44	-3141.00	-1404.67	-13227.80	11491.48	-12802.00	11065.62	1736.33

Murcia	3.00	-2484.00	1933.01	-9480.20	5063.19	-10761.20	6344.19	4417.01
Navarra	3.24	1266.00	1631.36	-1670.81	1305.45	-2195.59	1930.23	265.36
Ourense	-3.69	-1113.00	-1275.57	-514.05	676.62	114.90	47.67	-162.57
Asturias	-3.09	-5160.00	-3496.82	-1020.28	-632.91	-1362.23	-290.95	1653.19
Palencia	-3.44	-882.00	-399.82	-495.72	13.54	-193.47	-288.71	482.18
Palmas, Las	2.97	-11923.00	0.00	0.00	-11923.00	-17039.70	5116.71	11923.00
Pontevedra	-0.17	-5103.00	-3322.48	1112.89	-2893.41	-4891.45	3110.94	1780.52
Salamanca	-2.99	-2768.00	-1736.31	-1228.60	196.91	-1488.47	456.78	1031.69
Santa Cruz de Tenerife	4.29	-4283.00	0.00	0.00	-4283.00	-10664.90	6381.86	4283.00
Cantabria	-0.39	-2873.00	-2047.37	-1464.20	638.57	-2545.05	1719.41	825.63
Segovia	-2.60	-1311.00	-35.69	-574.23	-701.08	-724.72	-550.59	1275.31
Sevilla	0.33	-14517.00	-90.68	-16605.00	2178.68	-16681.00	1254.70	14426.32
Soria	-2.33	-439.00	37.67	-316.94	-160.73	-169.96	-316.71	476.67
Tarragona	2.73	-1744.00	933.66	-3188.09	510.43	-5472.48	2794.82	2677.66
Teruel	-3.42	-767.00	206.66	-669.27	-304.40	-107.44	-866.22	973.66
Toledo	1.50	-1124.00	-2519.29	-4454.87	5850.16	-2956.94	4352.23	-1395.29
Valencia	1.91	-7513.00	-5684.37	-13704.80	11876.12	-16376.10	13547.44	1828.63

Valladolid	-1.07	-2923.00	-2906.09	-1717.38	1700.47	-2114.80	2097.90	16.91
Bizkaia	0.93	-2565.00	1010.53	-3287.78	-287.75	-4082.55	507.02	3575.53
Zamora	-7.00	-1896.00	-593.81	-379.05	-923.15	-569.15	-733.04	1302.19
Zaragoza	1.74	616.00	880.94	-3029.02	2763.07	-1905.84	1639.90	265.94

Source: own elaboration

Table 2.12 Spatial shift-share effect. Population between 16 and 64

POPULATION BETWEEN 16 AND 64								
Province	**Pop growth (%)**	**Total effect (TE)**	**Neighbourhood total effect (NTE)**	**Neighbourhood Cohort Mix (NCM)**	**Neighbourhood Competitive Effect (NCE)**	**Regional Cohort Mix (RCM)**	**Regional Neighbourhood effect (RNE)**	**Residual effect (RE)**
Álava	3.18	1193.00	1999.31	-2911.72	2105.41	-5486.43	4680.12	806.31
Albacete	-1.60	-4487.00	-1834.67	-728.04	-1924.30	-348.19	-2304.14	2652.34
Alicante	1.34	10607.00	13281.09	-4822.75	2148.66	-5529.87	2855.78	2674.09
Almería	3.37	10981.00	6385.19	-1162.90	5758.70	-5043.74	9639.55	-4595.81
Ávila	-4.40	-5714.00	-610.10	-1124.09	-3979.81	-1220.83	-3883.07	5103.90
Badajoz	-2.13	-11888.00	-5292.17	-2962.36	-3633.48	-2342.85	-4252.98	6595.83
Balears, Illes	6.07	47603.00	0.00	0.00	47603.00	1731.93	45871.07	-47603.00
Barcelona	3.97	146085.00	85397.01	-26850.10	87538.09	3062.68	57625.32	-60688.00
Burgos	-1.75	-8874.00	-1395.26	-3811.72	-3667.02	-4829.65	-2649.09	7478.74
Cáceres	-3.75	-12337.00	-5207.68	-2355.08	-4774.23	-2585.66	-4543.66	7129.32
Cádiz	0.08	-8780.00	12071.54	-4443.44	-16408.10	-9427.29	-11424.30	20851.54
Castelló	0.56	-2132.00	1649.22	-2718.64	-962.58	-4271.95	590.74	3681.22

Ciudad Real	-3.63	-16189.00	-6473.10	-414.61	-8301.30	-3007.65	-5708.26	8716.91
Córdoba	-2.10	-13013.00	-5009.89	-2543.85	-5459.26	-2116.81	-5886.30	8003.11
Coruña, A	-0.47	-19966.00	-12638.10	-13023.70	5695.85	-16632.40	9304.55	7327.87
Cuenca	-3.78	-3822.00	616.05	-604.65	-3833.40	1034.31	-5472.36	4438.05
Girona	3.82	16539.00	11204.72	-1406.74	5741.02	-3279.08	7613.36	-4334.28
Granada	-0.31	-4229.00	2652.66	-2147.41	-4734.24	-2345.52	-4536.14	6881.66
Guadalajara	3.28	5676.00	-1423.71	-438.13	7537.84	162.22	6947.49	-7099.71
Gipuzkoa	1.44	-174.00	11125.95	-7335.42	-3964.53	-6693.69	-4606.26	11299.95
Huelva	0.58	505.00	-2002.48	-2751.52	5258.99	-1614.66	4022.13	-2507.48
Huesca	-0.10	-882.00	2613.92	-1166.86	-2339.06	-741.14	-2754.78	3495.92
Jaén	-3.48	-14787.00	-8192.04	-1957.91	-4637.05	161.94	-6746.91	6594.96
León	-4.79	-20796.00	-9473.25	-6739.21	-4583.54	-6395.29	-4927.46	11322.75
Lleida	0.57	-241.00	6898.17	-1713.64	-5425.53	-1859.66	-5279.50	7139.17
Rioja, La	0.90	-489.00	1662.98	-2692.41	540.42	-2329.44	177.46	2161.98
Lugo	-3.37	-10374.00	-5039.94	-4721.37	-612.70	-3404.51	-1929.55	5334.06
Madrid	5.33	201893.00	-51442.30	-10348.30	263683.60	-26364.00	279699.30	-253335.00
Málaga	3.44	32164.00	-5391.03	-7102.86	44647.90	-4924.17	42469.20	-37545.00

Murcia	3.00	28114.00	6797.05	-4956.78	26273.73	-991.10	22308.05	-21317.00
Navarra	3.24	10044.00	5900.18	-5565.98	9709.81	-3293.12	7436.95	-4143.82
Ourense	-3.69	-10696.00	-7220.24	-3464.71	-11.05	-3745.60	269.85	3475.76
Asturias	-3.09	-41050.00	-19252.60	-13641.50	-8165.98	-20195.50	-1601.92	21797.45
Palencia	-3.44	-6300.00	-2122.07	-2440.89	-1737.04	-2645.60	-1632.33	4177.93
Palmas, Las	2.97	22869.00	0.00	0.00	22869.00	-175.72	23044.72	-22869.00
Pontevedra	-0.17	-13160.00	-16342.20	-12146.90	14329.02	-12183.20	14365.30	-2182.16
Salamanca	-2.99	-9207.00	-8527.88	-3404.59	2725.47	-2922.58	2243.46	679.12
Santa Cruz de Tenerife	4.29	28900.00	0.00	0.00	28900.00	-767.30	29667.30	-28900.00
Cantabria	-0.39	-10212.00	-9271.32	-8502.33	7561.65	-8726.89	7786.21	940.68
Segovia	-2.60	-2995.00	-168.63	-1105.65	-1730.73	-389.52	-2446.86	2836.38
Sevilla	0.33	-4900.00	-330.51	-7604.71	3035.22	-9142.74	4573.25	4569.50
Soria	-2.33	-1365.00	176.25	-506.49	-1034.76	-59.57	-1481.68	1641.25
Tarragona	2.73	9290.00	3502.98	-3014.66	8801.68	-4698.76	10485.79	-5787.02
Teruel	-3.42	-3189.00	930.16	-448.66	-3670.49	-220.45	-3898.70	4119.16
Toledo	1.50	4438.00	-9317.62	-2577.37	16332.99	-2341.16	16096.78	-13755.60
Valencia	1.91	16845.00	-23137.40	-3894.00	42876.41	-16160.50	55142.93	-38982.40

Valladolid	-1.07	-12808.00	-13081.80	-5464.41	5738.24	-9169.89	9443.72	-273.83
Bizkaia	0.93	-3694.00	4570.60	-16569.40	7304.84	-10557.80	2293.22	8264.60
Zamora	-7.00	-9446.00	-3446.01	-2255.14	-3744.86	-1746.00	-4254.00	6000.00
Zaragoza	1.74	4535.00	3727.94	-3304.73	4111.79	-6132.58	6939.64	-807.06

Source: own elaboration

Table 2.13 Spatial shift-share effect. Population More than 65

POPULATION MORE THAN 65								
Province	Pop growth (%)	Total effect (TE)	Neighbourhood total effect (NTE)	Neighbourhood Cohort Mix (NCM)	Neighbourhood Competitive Effect (NCE)	Regional Cohort Mix (RCM)	Regional Neighbourhood effect (RNE)	Residual effect (RE)
Álava	3.18	7324.00	601.11	3865.54	2857.35	5316.77	1407.12	-6722.89
Albacete	-1.60	2459.00	-516.92	3507.80	-531.88	3625.11	-649.20	-2975.92
Alicante	1.34	18551.00	3906.47	20381.10	-5736.57	13804.53	839.99	-14644.50
Almería	3.37	10457.00	1314.36	5263.88	3878.77	7168.39	1984.25	-9142.64
Ávila	-4.40	-352.00	-247.99	2433.63	-2537.64	1474.38	-1678.38	104.01
Badajoz	-2.13	4368.00	-1499.99	7644.28	-1776.29	7073.43	-1205.45	-5867.99
Balears, Illes	6.07	16632.00	0.00	0.00	16632.00	6516.53	10116.47	-16632.00
Barcelona	3.97	76603.00	23978.61	57457.74	-4833.35	36443.79	16180.60	-52624.40
Burgos	-1.75	4441.00	-489.73	5213.84	-283.11	5860.56	-929.83	-4930.73
Cáceres	-3.75	1727.00	-1779.88	4140.95	-634.07	5059.80	-1652.93	-3506.88
Cádiz	0.08	21485.00	2717.50	13304.88	5462.62	21339.29	-2571.79	-18767.50
Castelló	0.56	8134.00	426.66	5316.96	2391.39	7544.65	162.69	-7707.34
Ciudad Real	-3.63	1812.00	-1909.50	4517.86	-796.36	5405.38	-1683.88	-3721.50

Córdoba	-2.10	5435.00	-1413.09	9129.79	-2281.70	8508.38	-1660.29	-6848.09
Coruña, A	-0.47	16011.00	-4616.40	14676.13	5950.27	17228.41	3397.99	-20626.40
Cuenca	-3.78	-1605.00	225.63	2241.07	-3971.70	273.66	-2004.30	1730.63
Girona	3.82	12259.00	2912.19	4917.10	4429.72	7368.05	1978.77	-9346.81
Granada	-0.31	7999.00	687.48	9455.77	-2144.25	8487.13	-1175.61	-7311.52
Guadalajara	3.28	2835.00	-332.65	1082.18	2085.48	1644.37	1623.29	-3167.65
Gipuzkoa	1.44	12627.00	3687.90	9453.17	-514.07	10465.93	-1626.83	-8939.10
Huelva	0.58	5735.00	-472.08	6917.58	-710.50	5258.87	948.21	-6207.08
Huesca	-0.10	712.00	910.06	2088.93	-2286.99	761.04	-959.10	198.06
Jaén	-3.48	3098.00	-2307.63	6537.61	-1131.98	7306.18	-1900.55	-5405.63
León	-4.79	1622.00	-3889.87	8089.25	-2577.38	7535.17	-2023.30	-5511.88
Lleida	0.57	3774.00	1979.12	3625.21	-1830.33	3309.60	-1614.72	-1794.88
Rioja, La	0.90	4368.00	513.30	3177.05	677.65	3799.93	54.77	-3854.70
Lugo	-3.37	-787.00	-2364.59	6527.21	-4949.62	2482.87	-905.29	-1677.59
Madrid	5.33	128826.00	-12964.60	33934.25	107856.30	71300.23	70490.36	-141791.00
Málaga	3.44	26919.00	-1336.61	20613.14	7642.47	17726.12	10529.50	-28255.60
Murcia	3.00	18333.00	1636.82	11850.72	4945.46	11752.31	5043.87	-16796.20

Navarra	3.24	9411.00	1735.17	6566.42	1109.41	5488.71	2187.12	-7675.83
Ourense	-3.69	68.00	-3701.03	5210.33	-1441.30	3630.71	138.32	-3769.03
Asturias	-3.09	13755.00	-7203.40	16307.42	5650.98	21657.76	-599.36	-20958.40
Palencia	-3.44	1468.00	-796.17	3281.53	-1017.36	2839.07	-574.90	-2264.17
Palmas, Las	2.97	21713.00	0.00	0.00	21713.00	17216.43	4497.58	-21713.00
Pontevedra	-0.17	16760.00	-4941.07	8475.98	13225.09	17074.60	4626.47	-21701.10
Salamanca	-2.99	1825.00	-3509.23	5109.59	224.64	4411.05	923.19	-5334.23
Santa Cruz de Tenerife	4.29	18267.00	0.00	0.00	18267.00	11432.16	6834.84	-18267.00
Cantabria	-0.39	10811.00	-2877.53	8266.72	5421.81	11271.93	2416.60	-13688.50
Segovia	-2.60	214.00	-54.81	1870.18	-1601.37	1114.23	-845.42	-268.81
Sevilla	0.33	25813.00	-77.06	21484.77	4405.29	24823.77	1066.29	-25890.10
Soria	-2.33	-318.00	72.57	1129.88	-1620.45	219.53	-610.10	390.57
Tarragona	2.73	14008.00	960.78	5612.10	7435.12	10171.24	2875.98	-13047.20
Teruel	-3.42	-800.00	353.41	1645.95	-2799.36	327.89	-1481.30	1163.41
Toledo	1.50	7087.00	-2458.76	5459.43	4086.33	5298.10	4247.66	-9545.76
Valencia	1.91	40228.00	-6283.19	16037.71	30473.48	31636.59	14974.60	-46511.20
Valladolid	-1.07	10092.00	-4288.65	5811.49	8569.17	11284.69	3095.96	-14380.70

Bizkaia	0.93	16957.00	1642.65	19940.18	-4525.82	14640.36	773.99	-16414.40
Zamora	-7.00	-1606.00	-1710.09	3423.24	-3219.16	2316.15	-2111.06	-204.09
Zaragoza	1.74	11420.00	1181.74	7120.20	3118.06	8038.42	2199.84	-10238.30

Source: own elaboration

CHAPTER 3. REGIONAL URBANIZATION LEVELS: POPULATION DISTRIBUTION AND REGIONAL GROWTH

3.1.- Introduction

The question of whether agglomeration through urban growth influences economic activity could be on the base of the regional growth processes. Within the discipline of geographical economics, multiple scholars have studied the interaction between urbanization and developmental trajectories (Jacobs, 1969; Gallup et al., 1999). These studies underscore the pivotal role played by urban population expansion in catalyzing economic progress while concurrently accentuating the presence of disparities within national contexts (Williamson, 1965).

Starting from the premise that cities act as drivers of economic growth (Black and Henderson, 1999), our objective is to analyse the relationship between the different degrees of urbanization that exist within regions and economic growth. The levels (degrees) of urbanization are evaluated through the existing typologies for each municipality or city: urban, semi-urban and rural population. In this way, it is intended to determine the internal aggregate composition in terms of population structure that would favour regional development. The effects of population composition can result in both positive effects (i.e. derived from economic agglomeration) or negative effects (e.g. congestion).

We consider the shares of population in urban and semi-urban areas as a measure of demographic agglomeration. Our research considers that the internal aggregate level of urbanization within a region is a key determining factor for the regional development. The purpose is to investigate the relationship between the internal regional agglomeration and regional economic growth. This relation aligns with the longstanding debate surrounding the balance between efficiency and equity extensively deliberated in 20th-century economic literature, as expounded upon by Williamson (1965). Williamson's work illustrates that during initial phases of economic progression, the dichotomy between efficiency and equity is conspicuous but diminishes beyond a particular developmental threshold, occasionally exerting a negative impact on efficiency. Hence, Williamson posits that the optimal degree of urban concentration within a nation hinge upon its stage of economic development. While urbanization and development are endogenous processes, their relationship is not always clear (Jacobs, 1969). According to Gallup et al. (1999), urbanization is not solely a consequence but can also act as a driver of economic development. The growth of urban populations over time and across countries is a crucial factor in explaining economic development; however, it can also be a source of inequalities, as is expressed using Williamson's hypothesis (1965).

In this context, the analysis of Williamson's hypothesis using different perspectives, has lighted the connection between the level of development in a country and the impact of urban agglomeration on economic growth. This approach has proven useful in analysing the complex relationships between urbanization and regional development, highlighting the critical role of cities in fostering economic growth and creating a sustainable environment for their inhabitants. These studies could contribute to our understanding of regional development, providing valuable insights for policymakers in designing effective strategies for promoting economic growth. This could be achieved through measures that either encourage or discourage population concentration within regions.

Therefore, in this work we extend the concept of size of cities and link it to the heterogeneity of regions, measured through the level of urbanization of municipalities within the region. We aim to analyse the relationship between the level of urbanization of regions and the economic growth. Our research builds on Eurostat's classification of municipalities, urban, semi-urban and rural (Dijkstra and Poelman, 2014), aiming to determine the population structure that enhances regional development and generates positive or negative effects on economic growth. We examine the impact of varying levels of urbanization on the economic growth of regions (provinces), seeking to discern the distinctive contributions of urban, semi-urban, and rural areas to the economic growth of regions.

In alignment with Williamson's hypothesis, our study is focused on analysing the impact of demographic agglomeration on economic growth according to the type of agglomeration: urban or semi-urban, distinguishing the effect according to the level of economic development of Spanish regions. In addition, our analysis is extended to determine the population structure most conducive (urban, semi-urban and rural) to stimulate GDP per capita growth in the Spanish provinces. We try to understand the contribution of urban and semi-urban population types to regional economic growth.

Drawing from this theoretical framework and the Williamson Hypothesis, a regional urban share threshold exists beyond which the increase in urban population would exert a negative influence on economic growth. Our main purpose is to test the Williamson Hypothesis, quantifying this urban share threshold. Hence, for the case of the Spanish provinces this paper estimates the urban population share where the benefits of urban agglomeration are optimal.

The examination of urban population is intrinsically tied to the exploration of development in 'other areas,' such as rural or semi-urban locations. However, studies on the role of intermediate cities on economic development are relatively scarce in this literature. In recent years there has been a notable increase in studies on the size of cities and their influence on economic growth. These studies are mainly focused on the interaction and spillovers between cities of different sizes (Adler and Florida, 2021, Camagni, et. al 2013, Camagni, et. al 2017). By shifting attention to these areas, researchers have gained new insights into the dynamics of regional development and the ways in which intermediate zones can contribute to sustainable growth. This renewed emphasis on intermediate zones underscores the importance of taking a holistic approach to territorial development, one that considers the unique characteristics of different regions and their potential for contributing to broader regional development goals, (Camagni, et al, 2017, Alamá-Sabater, et al. 2022 a, 2022b).

In addition to the analysis focused on urban population dynamics, this study also explores the impact of the semi-urban population share within the regional demographic structure. Consequently, it aims to examine the influence of the semi-urban population share on regional economic growth.

Our results indicate that the presence of urban population is necessary, as urban agglomeration enhances GDP growth, but only up to a specific point, which in our study is estimated to be around 32,000 euros. Beyond this point, the benefits of agglomeration will gradually diminish. On the other hand, while the Williamson hypothesis holds true for urban population dynamics, it doesn't necessarily apply to semi-urban populations. In fact, semi-urban population tends to have generally positive effects on the level of development.

The structure of paper is as following: the next Section presents a review of the literature on the relationship between economic growth and population agglomeration.

Section 3 shows and explores the population of each province at its three levels, urban, semi-urban and rural. Section 4 presents the model that will allow us to know how the structure of the urbanization of the population affects economic growth. Results are discussed in Section 5. Finally, Section 6 provides main conclusions.

3.2.- Theoretical background

Exploring how urbanization influence the regional growth process stems from fundamental aspects shared by both endogenous growth theory and urban studies: external scale economies (Romer, 1986) and knowledge spillovers Lucas (1988). Economic theories such as those of endogenous growth pay great attention to urbanization because of the spillover effects produced by the accumulation of human capital and knowledge on the growth of a given urbanized area (Lucas, 1988, Romer, 1994; Davis, Fisher and Whited, 2014). Thus, the study of the concentration of economic activity and its influence on growth is already a classic study in the field of geographical economics. New Geographical Economics researchers such as Fujita, Krugman and Venables (1999) or Fujita and Thisse (2002) have delved extensively into the relationship between urbanization and productivity, also highlighting the influence of agglomeration economies on productivity differences between large and smaller cities (Glaeser, 1998 or Henderson, 1988 and 2003).

Some studies of the last decades such as Duranton and Puga (2002, 2014, 2019) analyse the relationship between agglomeration and the emergence of new firms, paying special attention to population growth spillovers in developed economies or the effect of city growth on economic growth and aggregate income. In this regard, Desmet, Nagy and Rossi-Hansberg (2018) delve into the prediction of countries' growth rates based on the accumulation of physical capital and knowledge spillovers between cities.

For some researchers, urbanization and economic growth are related (Lucas, 2004; Michaels, Rauch and Redding, 2012), with advantages associated with urban concentration (Beardsell and Henderson, 1999; Rosenthal and Strange, 2001; Glaeser and Maré, 2001, Baum-Snow and Pavan, 2012, De la Roca and Puga, 2017). However, for others, this is not the case (Fay and Opal, 2000; Glaeser, 2014; Desmet and Henderson, 2015; Gollin, Jedwab and Vollrath, 2016), and the evidence of this can be seen in what is happening in some Arab and African countries. In fact, agglomeration economies can also trigger diseconomies and the crowding-out effect due to increases in wages and land prices (Henderson and Thisse, 1997); increased transport costs (Duranton and Turner, 2012) and commuting (Duranton and Puga, 2001) and affordable housing within large cities (Combes, Duranton, and Gobillon, 2019), or congestion or pollution costs (Fujita and Thisse, 2003; Henderson, 2003; Martin and Ottaviano, 2001) and social inequality (UN, 1993), which in turn can hinder the associated agglomeration economies (Fallah and Partridge 2007; Behrens and Robert-Nicoud, 2011).

Research that delves into the characteristics of rural life and its relationship with the nearest congested cities reveals the preference of families and businesses to settle in rural areas, motivated among other factors by the increasing distance between the place of residence and the place of work (Champion, 1998), by the negative effects of urban agglomeration (Broersma and Dijk, 2008) or by the characteristics of rural life (van Dam, Heins, and Elbersen, 2002; Heins, 2004; Aner, 2016; Dunlop, S., Davies, S., and Swales, K. (2016); Sørensen JFL. (2014). However, this trend that is being observed in Anglo-Saxon European countries is not occurring in Latin countries (van Leeuwen, E.S., 2010, 2015).

The economics of well-being and happiness has also addressed the advantages and disadvantages of urban concentration, analysing the subjective well-being of the inhabitants of large cities. Loschiavo (2021) finds evidence that inhabitants of large cities enjoy lower well-being due to the negative effect of commuting to work, from the perspective of less time available to foster personal relationships and leisure activities. Other researchers (Berry and Okulicz-Kozaryn 2011, Easterlin et al. 2011, Winters and Li 2017) also corroborate lower well-being for city dwellers generically. Glaeser et al. (2016) particularizes this welfare loss for declining cities in the US. Nevertheless, from the point of view of individual well-being, Lenzi and Perucca (2021) question this for twenty-one EU countries between 2005 and 2010, and empirically demonstrate the positive relationship between urbanisation and individual well-being the shorter the distance to a larger city than where one resides, thus corroborating that the positive externalities of a city can expand beyond urban boundaries. While other researchers such as Diamond (2016); or Carlsen, F., and Leknes, S. (2022) consider that it is the level of education that determines the level of exploitation of the benefits of living in urban areas.

The relationship between agglomeration and economic growth links to the trade-off between efficiency and equity that is so present in regional policymaking (van Dijk et al., 2019). The presence of this dilemma in the economic literature is reflected in the 20th century contributions of Kuznets (1955), Myrdal (1957), Hirschman (1958), Easterlin (1960) and others, among whom we highlight Williamson (1965) for his empirical estimation of the trade-off, known as the Williamson Hypothesis. In his study on the convergence of per capita incomes at the regional level, Williamson shows that in the early stages of economic development the trade-off between efficiency and equity is present but ceases to be present after a certain level of development, even negatively affecting efficiency. His reasoning is that urban concentration is desirable when a country is poor, as it can save on the infrastructure costs of accommodating more population in less developed cities. However, as the country develops, urban concentration should decrease as the economy can afford the cost of extending infrastructure and knowledge to more remote areas of the country, and cities with higher concentration become more congested and less efficient (Cuberes, 2020). Thus, for Williamson, the optimal level of urban concentration in a country depends on its economic development. Brülhart and Sbergami (2009) support this hypothesis by estimating at $10,048 (valued in 2006 purchasing power parity) the level of per capita income in the country after which agglomeration ceases to stimulate GDP growth. Wheaton and Shishido (1981) also estimated for thirty-eight developed and undeveloped countries the level of GDP pc ($8,384) that causes a negative relationship between concentration and growth. Aroca et al. (2014) study this fact in Latin America to corroborate Williamson's (1965) hypothesis in the regions of Brazil, Mexico and Chile, reaching different results in each case, as concentration would be negative for growth in the cases of Brazil and Chile but not for Mexico. However, none of the above studies provide the level of per capita income at which agglomeration ceases to stimulate GDP per capita with an estimate of the optimal level of regional agglomeration (urban concentration share) at which this occurs[41]. In this regard, the findings of our study make several contributions to the current literature.

Other studies focus on the relationship between inequality and economic growth, such as Chen (2003), who obtains a Gini Index (0.37) that maximizes growth when

[41] Most commonly, scholars define urbanization as the proportion of a country or region's population that lives in urban areas (Gross and Ouyang, 2021). In our case, urban agglomeration is defined with the share of population living in municipalities that are classified as urban. Semi-urban agglomeration is defined by the share of population that are living in municipalities classified as semi-urban (DEGURBA project).

analysing this relationship for East Asia and Western Europe in 1970. The relationship also varies depending on the initial level of inequality, adopting an inverted U-shape. Hailemariam and Dzhumashev (2019) also examine the relationship between income inequality and economic growth in a large panel of countries over the period 1965-2014. Given their heterogeneity, the non-linear relationship between the two variables remains significant, identifying a larger threshold effect of inequality on growth in developing countries than in developed countries. Castells-Quintana and Royuela (2014) analyse the effects of income inequality and agglomeration on economic growth in fifty-one countries around the world between 1970 and 2007. Their results show that high levels of inequality limit long-term growth and that high levels of urban population concentration are associated with economic growth, although this is influenced not only by the initial conditions of these variables but also by their evolution over time and the interaction between the two processes.

At the institutional level, the World Bank and the OECD have dealt with the dilemma between efficiency and equity, as their reports and territorial studies amply reflect. Specifically, the OECD Report published in 2010 addresses the problems of regional development under the headings of “old and new paradigm”. The “old paradigm” refers to regional policies based on equity, which were applied until the 1990s or so and whose objective was to achieve it through a more balanced regional development within the country. The “new paradigm”, however, focuses on the objective of efficiency, i.e. on the problems of competitiveness and underutilisation of resources, relegating the problems of inequality to the background. It is on this basis that the European Union's Regional and Cohesion Policy was designed in the period 2007-2013 (Cuadrado, J.R., 2011). Frick and Rodriguez-Pose (2018a, 2018b), also raise the dilemma when analysing the effects of urban concentration on the economic growth of countries, as their results differ from what has traditionally been recognised from the NGE. They find that urban concentration is beneficial for economic growth in high-income countries and detrimental for developing countries and suggest that there is no uniform relationship between urban concentration and economic growth, so they recommend that when establishing policies, these should be country-specific, so that the economic potential of the city and the urban agglomeration can be harnessed in each particular case. Castell-Quintana (2017) also shows that the correlation between economic growth and urban concentration is negative in the world's poorest countries.

The economic develop, to last decades, has changed significantly, and these changes have been determined by the size of cities. McCann and Acs (2011) suggest that medium-sized cities are more productive than the world's largest cities. Frick and Rodríguez-Pose (2018a, 2018b) address the role of large cities in countries with low or medium-high levels of development, highlighting the importance of city size in their contribution to economic growth. Literature about this topic suggest that agglomeration of people and firms and thus larger cities, increase peoples and companies' productivity, therefore agglomerations are contributing to economic growth (Fujita and Thisse 2003; Martin and Ottaviano 2001). On the other side, larger city size leads to increased rents and commuting time, which reduces people's productivity.

Taken all together, a city's productivity is believed to follow an inverted U-shape function of total urban employment. Productivity increases with city size up to a certain population threshold, beyond which the disadvantages of agglomeration overshadow its benefits (Duranton and Puga (2004). Brülhart and Sbergami (2009) and Castells-Quintana and Royuela (2014), use the percentage of the urban population living in cities above 750,000 or 1 million inhabitants as an alternative indicator for urban concentration and thus generate city size related empirical evidence as an interesting "side product." Both studies find support for the big-city-growth-relationship: the larger the percentage of the population living in cities above these thresholds, the better the economic performance of countries, particularly at low levels of economic development.

The different size of cities has approach literature in recent years, paying special attention in how the economic growth could be influenced by the size of cities/ regions. In the field of agglomeration economics, many scholars have grappled with the complexities inherent in this topic. Camagni, Capello and Caragliu (2016) analyses the role of agglomeration economies in relation to the size of cities as sources of productivity increases. Diferents authors, (Alonso, 1971, Segal, 1976, Marelli, 1981, Rousseaux and Proud'homme, 1992, Rousseaux, 1995, Capello, 1998), argue and demonstrate that productivity depends on size of cities[42]. According to Camagni et al. (2016), establishing

[42] According to Camagni et al (2016, p. 137) "Alonso finds that average labour productivity is greater in American cities with more than 5 million inhabitants, showing that location costs are minimized for an urban size smaller than the one maximizing location advantages (Alonso 1971). Estimating an aggregate urban Cobb-Douglas production function on a sample of 58 American cities, Segal finds that metropolitan areas with more than 3 million inhabitants are 8% more productive than other cities (Segal 1976). In a cross-sectional study on 230 American cities, Marelli obtained similar results: larger cities are more productive than smaller ones up to a certain threshold, beyond which productivity runs into decreasing returns (Marelli 1981). Other empirical studies found that productivity was 30%

an ideal size threshold is complex because urban location advantages are the result of other city attributes, such as quality of life or amenities. Consequently, using the same production function to determine the optimal size of a city is not easy.

Also, the aggregated configuration of local areas conforms a regional urbanization structure. According to the literature, there is consensus in stating that urban population will have higher productivity than rural population. Consequently, it is expected that a region with a higher urban share will have greater productivity than a region with a higher rural population. While it is common in the literature to analyse the significance of the urban share within this structure, the examination of the semi-urban share has received less attention. The effect of regional interurban population (semi-urban share) has not been the subject of empirical analysis that allows establishing the effect of the presence of this type of population within regions.

In addition to the impact of agglomeration economies, the advantages and higher productivity of small/intermediate cities could derive from the "borrowing" of agglomeration benefits they can make from neighbouring large cities (Alonso, 1973). This approach is similar to the concept of spillovers treated by Alamá, et al (2022 a, 2022b) concerning the spatial effects stemming by the spatial dependence of factors such population and employment between nearby urban and semi-urban or semi-urban and urban municipalities that are neighbours. In this scenario, the geographic proximity of areas of different degrees of urbanization structures makes possible that rural or semi-urban areas take advantage of agglomeration economies.

Therefore, Camagni (2016, p.139) indicates, that "*no threshold effect is thus identified*", since "*small cities grow because they can achieve higher productivity by borrowing from larger agglomerations, and large cities grow because they exploit the attractiveness due to their own higher productivity*". This raises two separate issues. That is, due to its relevance in terms of regional development, the semi-urban case should be analysed as a unit part.

On this point, we argue that the effects of population size on economic growth is complex and should be study considering that spatial effects or the borrowing of agglomeration effects could generate an internal process on small or intermediate areas

greater in the Iˆle de France and 12% greater in Marseille, Lyon and Nice than in the rest of France (Rousseaux and Proud'homme 1992; Rousseaux 1995). For Italy, on the basis of a cross-section of 58 Italian cities, Capello (1998) finds that gross average urban benefits exhibit an inverted U shape, decreasing beyond a certain threshold".

that makes necessary to analyse both structures in a separate way. This approach makes it possible to identify the different patterns associated with urban and semi-urban structures, clarifying the relationship between the population structure and the economic development of the regions.

Thus, this paper aims to analyse the influence of the internal regional mix relative to population composition on the level of regional development. The novelty of our analysis is that it does not focus exclusively on the case of large cities, but aims to work at the aggregate level, identifying possible thresholds that are relevant when it comes to suggesting how the population should be distributed within a region[43].

From this role of cities (municipalities) according to their size, our idea is to determine the contribution of population to the economic growth of Spanish Regions. Spanish regions are composed of municipalities, and municipalities are heterogeneous. Their heterogeneity is determined basically by the level of urbanization of each one of the municipalities. Eurostat classify municipalities in three categories: urban, semi-urban (intermediate) and rural. Therefore, regions are composed by different shares of urban, semi-urban and rural population.

From a theoretical perspective, our main contribution is that, considering Williamson Hypothesis and the role of urban agglomeration on economic growth, we introduce a novel framework that considers the different levels of urbanization between cities (municipalities) and the heterogeneous characterization of regions in terms of urban, semi-urban and rural population. Based on the relationship between city size and productivity (Camagni, 2017), we analyse the different pattern of urban and semi-urban in terms of their impact on regional economic development. Concretely, starting from the approach in which a region is configured taking into account the different levels of urbanization of its population (urban, semi-urban, and rural), this study aims to identify the optimal urbanization regional configuration for maximizing regional per capita income growth.

Under this theoretical point of view, our main objective is to study the following points: a) To what extent does the urban population share contribute to economic

[43] The limitation of working with this aggregate approach is that it does not take into account the distances between municipalities. However, our approach would provide complementary information to an analysis with a lower level of aggregation (in which the unit of analysis would be the municipalities).

development. It is expected that increasing the level of urban population share the agglomeration economies operates until to get a point where due to congestion economies the regional development decreases. This point is what in this paper we are going to denote as urban threshold. b) To what extent does the semi-urban population share contribute to economic development. Following the previous argument, does exist a semi-urban threshold?

3.3.- Data description, Spatial structure of population and exploratory analysis

Degree of urbanization at LAU-2

In 2014 European Commision's Directorate-General for Regional and Urban Policy (DG REGIO) published a Harmonised definition of cities and rural areas: the new degree of urbanisation (Djkstra and Poelman, 2014). This document describes the degree of urbanization classification and distinguished three different classes: cities, towns and suburbs, and rural areas (or densely, intermediate and thinly populated areas) that are based on information for population grids to provide more robust data.

On 2017 and 2018 European Parliament stablished a regulation about a common classification of territorial units for statistics (NUTS)[44]. The proposed methodology may be used to compile statistics according to the degree of urbanization. The methodology classifies the entire territory of a country along an urban-rural continuum (LAU-2). It combines population size and population density thresholds to capture three mutually exclusive classes: cities, towns and semi-dense areas, and rural areas.

According to Djkstra and Poelman, (2014). The new degree of urbanization creates a three-way classification of LAU-2:

- Densely populated area. At least 50% living in high-density clusters
- Intermediate density area. Less than 50% of the population living in rural grid cells and less than 50% living in a high-density cluster.
- Thinly populated area (alternative name: rural area). More than 50% of the population living in rural grid cells.

[44] Amending regulation (EU) 2017/2391, Regulation (EC) No 1059/2003

This classification has motivated different studies about the typology of territory and related with the implications of the levels of urbanization.

Following the classification of Djkstra and Poelman (2014), we divide population in three levels, and given the total of population in a Spanish province, we consider:

- Urban population share: population share who live in urban municipalities.
- Semi-urban population share: population share who live in semi-urban municipalities.
- Rural population share: population share who live in rural municipalities.

In the case of Spain, Table 3.1 illustrates the distribution of municipalities according to their level of urbanization. As can be seen in the table, more than half of the Spanish population resides in only 2.7% of the municipalities. This result highlights the unequal distribution of the population in Spain, with a significant concentration in urban areas.

Table 3.1 Levels of urbanization of municipalities in Spain (2020)

DEGURBA	Number of municipalities	Total population	Percentages municipalities	Percentages population
Urban	219	25.501.236	2,7	54,0
Intermediate	1.105	15.526.750	13,6	32,9
Rural	6.779	6.199.794	83,7	13,1
Total	8.103	47.227.780	10,00	100

Source: Own elaboration

Table 3.2 provides detailed information for each province, the number of semi-urban, rural, and urban municipalities and the percentage they represent. The last three columns show the proportion of the population living in urban, semi-urban, and rural areas for each province, all dates correspond to year 2020.

Table 3.2 Number of municipalities in each region according to the level of urbanization: Semi-Urban, Rural, Intermediate, 2020

	Number of municipalities				Percentage of number of municipalities			Population		
Provinces	Total municipalities	Urban municipalities	Semi-urban municipalities	Rural municipalities	Urban Percent	semi-urban Percent	Rural Percent	Share urban	Share Semi-urban	Share rural
Albacete	87	1	7	79	0.01	0.08	0.91	0.43	0.31	0.26
Alacant	141	8	60	73	0.06	0.43	0.52	0.50	0.46	0.04
Almería	102	1	19	82	0.01	0.19	0.80	0.28	0.53	0.19
Araba	51	1	2	48	0.02	0.04	0.94	0.75	0.09	0.16
Asturias	78	3	15	60	0.04	0.19	0.77	0.54	0.27	0.19
Ávila	248	1	3	244	0.00	0.01	0.98	0.34	0.12	0.54
Badajoz	164	2	21	141	0.01	0.13	0.86	0.30	0.36	0.34
Balears, Illes	67	2	28	37	0.03	0.42	0.55	0.41	0.46	0.12
Barcelona	311	38	105	168	0.12	0.34	0.54	0.74	0.22	0.04
Bizkaia	111	14	31	66	0.13	0.28	0.60	0.70	0.23	0.07
Burgos	371	1	4	366	0.00	0.01	0.99	0.48	0.23	0.29
Cáceres	219	1	11	207	0.01	0.05	0.95	0.23	0.32	0.45

Cádiz	44	8	22	14	0.18	0.50	0.32	0.69	0.28	0.03
Cantabria	102	2	20	80	0.02	0.20	0.78	0.40	0.39	0.21
Castelló	135	1	18	116	0.01	0.13	0.86	0.30	0.53	0.17
Ciudad Real	102	1	23	78	0.01	0.23	0.77	0.14	0.67	0.19
Córdoba	75	1	25	49	0.01	0.33	0.65	0.41	0.44	0.15
Coruña, A	92	3	26	63	0.03	0.28	0.69	0.37	0.37	0.26
Cuenca	238	1	6	231	0.00	0.03	0.97	0.26	0.23	0.51
Gipuzkoa	88	2	34	52	0.02	0.39	0.59	0.35	0.56	0.10
Girona	221	1	35	185	0.01	0.16	0.84	0.13	0.61	0.26
Granada	168	14	25	129	0.08	0.15	0.77	0.43	0.35	0.22
Guadalajara	288	1	7	280	0.00	0.02	0.97	0.34	0.31	0.35
Huelva	79	1	19	59	0.01	0.24	0.75	0.29	0.51	0.20
Huesca	202		7	195	0.00	0.04	0.97	0.00	0.59	0.41
Jaén	97	2	26	69	0.02	0.27	0.71	0.27	0.49	0.24
León	211	2	7	202	0.01	0.03	0.96	0.41	0.19	0.40
Lleida	231	1	18	212	0.00	0.08	0.92	0.31	0.30	0.39

Lugo	67	1	7	59	0.02	0.10	0.88	0.28	0.25	0.47
Madrid	179	19	63	97	0.11	0.35	0.54	0.84	0.14	0.02
Málaga	100	5	18	77	0.05	0.18	0.77	0.57	0.33	0.10
Murcia	45	3	33	9	0.07	0.73	0.20	0.51	0.47	0.02
Navarra	272	10	14	248	0.04	0.05	0.91	0.46	0.22	0.32
Ourense	92	1	5	86	0.01	0.05	0.94	0.33	0.19	0.48
Palencia	191	1	5	185	0.01	0.03	0.97	0.48	0.17	0.36
Palmas, Las	34	4	21	9	0.12	0.62	0.27	0.56	0.40	0.04
Pontevedra	60	2	28	30	0.03	0.47	0.50	0.40	0.44	0.16
Rioja, La	174	1	8	165	0.01	0.05	0.95	0.48	0.28	0.24
Salamanca	362	1	9	352	0.00	0.03	0.97	0.44	0.21	0.35
Santa Cruz de Tenerife	53	4	29	20	0.08	0.55	0.38	0.43	0.50	0.07
Segovia	209		5	204	0.00	0.02	0.98	0.00	0.50	0.50
Sevilla	105	12	52	41	0.11	0.50	0.39	0.57	0.38	0.06
Soria	183		2	181	0.00	0.01	0.99	0.00	0.48	0.52
Tarragona	183	2	39	142	0.01	0.21	0.78	0.31	0.51	0.18

Teruel	236		3	233	0.00	0.01	0.99	0.00	0.42	0.58
Toledo	204	2	28	174	0.01	0.14	0.85	0.25	0.34	0.41
València	266	30	92	144	0.11	0.35	0.54	0.61	0.32	0.08
Valladolid	225	1	9	215	0.00	0.04	0.96	0.59	0.19	0.22
Zamora	248	1	2	245	0.00	0.01	0.99	0.34	0.15	0.51
Zaragoza	292	1	13	278	0.00	0.05	0.95	0.70	0.13	0.17

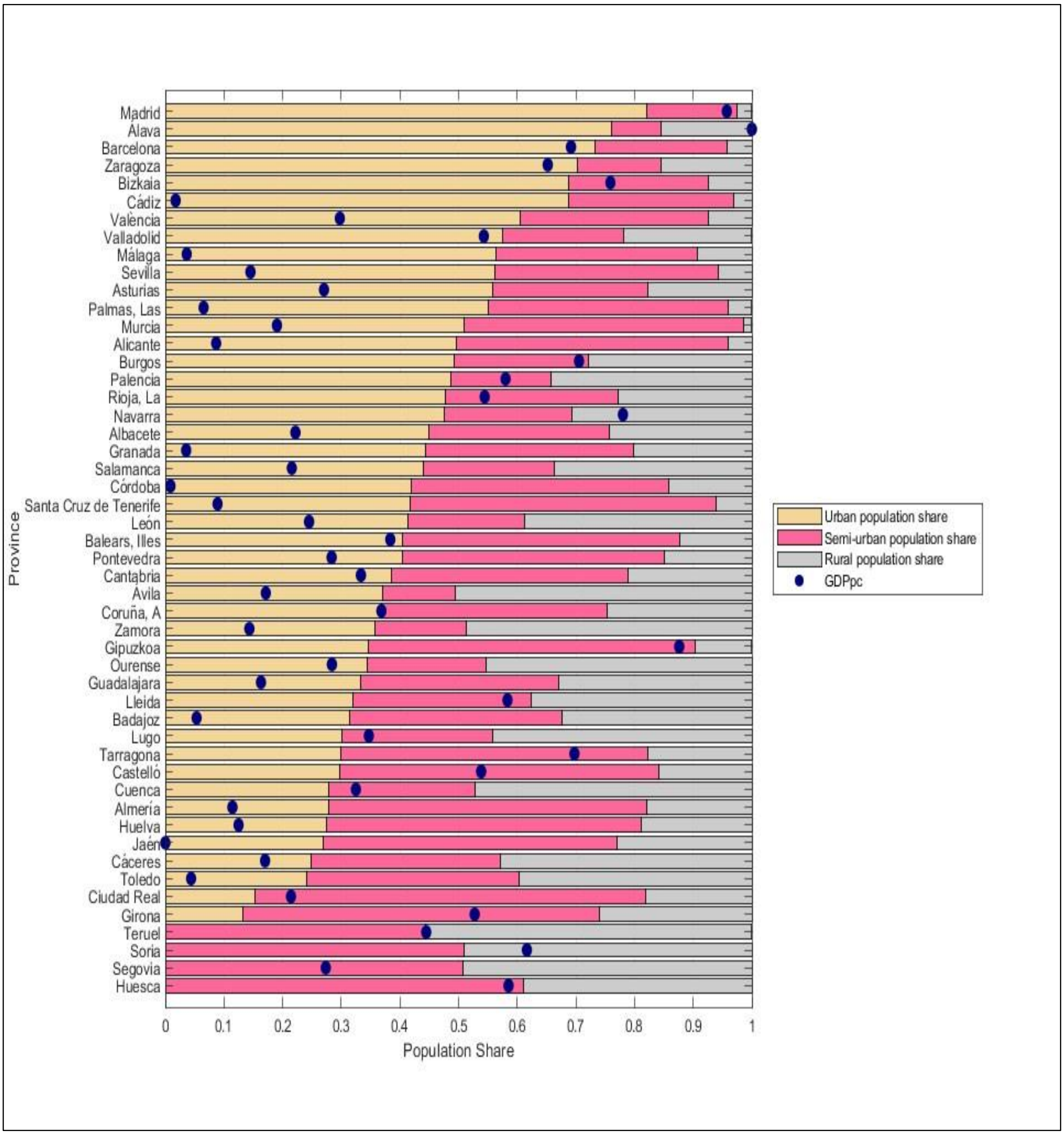
Source: Own elaboration

Figure 3.1 shows the distribution of the population in each of the 50 Spanish provinces (sorting total population decreasing) taking into account whether they live in an urban, semi-urban or rural municipality. Additionally, figure 3.1 includes the GDP per capita.

In Spain, 46 provinces have at least one city classified as urban, while 4 provinces (Huesca, Soria, Teruel and Segovia) do not have urban population. The province with the most urban population is Madrid, where 82% of the population lives in urban areas. On the opposite side is Girona and Ciudad Real, where less than 2% of the population is in urban areas. Therefore, as shown in Figure 3.1, the most significant urban demographic agglomerations are located in Madrid, Araba, Barcelona, and Zaragoza, where over 70% of the population resides in urban areas. These provinces also rank among the top ten in terms of GDP per capita.

In relation to the demographic agglomerations formed by the population living in semi-urban or intermediate cities, the results indicate that 11 provinces (Segovia, Soria, Santa Cruz de Tenerife, Tarragona, Huelva, Castelló, Almería, Gipuzkoa, Girona, Huesca y Ciudad Real) have more than 50% of their population located in semi-urban cities. It should be noted that these provinces have a total population of less than one million inhabitants (except Santa Cruz de Tenerife). In relation to rural population, the provinces with more of 40% of rural population are: Cáceres, Lugo, Orense, Cuenca, Zamora, Soria, Segovia, Ávila, and Teruel. On the other side, Murcia, Madrid, Cádiz, Las Palmas, Alicante, Barcelona, Sevilla, Santa Cruz de Tenerife, Valencia and Vizcaya, are the first ten provinces with less percentage of rural population.

Figure 3.1 Share of population in Spanish provinces (urban/semi-urban/rural), 2020

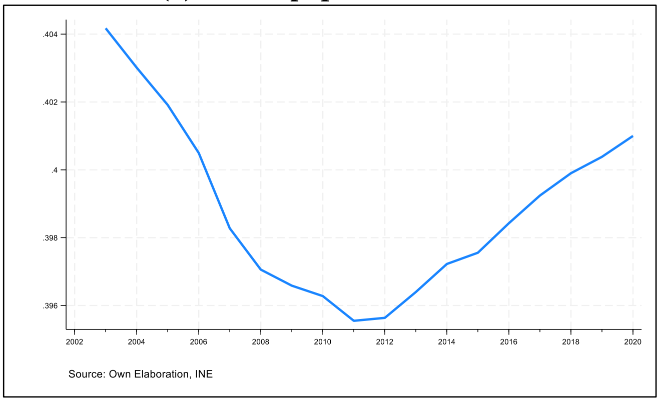


Source: own elaboration

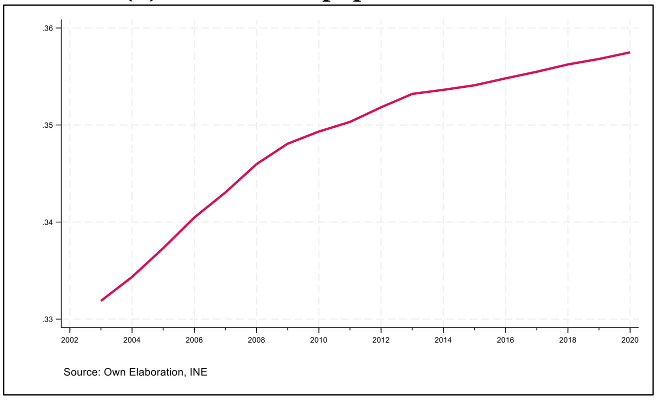
Figure 3.2 illustrates the changes in the percentage of urban (a) semi-urban (b) and rural (c) populations shares in Spain from 2003 to 2020. The data indicates a growing trend in the population residing in intermediate areas, while the urban population showed a decreasing pattern until 2012, after which it gradually started to increase. This graph highlights the correlation between population structure and economic cycles, where the overall urban population tends to increase during the recovery period. Finally, the share of the rural population reflects its continued decline throughout the period. This population tends to be older and with very low birth rates, which is causing the depopulation of many rural areas, especially in the interior and northwest of our country. This is leading to a great debate on alternatives for the survival of the rural world, as reflected in the political agenda of many institutions and in the economic literature of "the left behind places".

Figure 3.2 Urban, semi-urban and rural population in Spain, 2003-2020 (in shares)

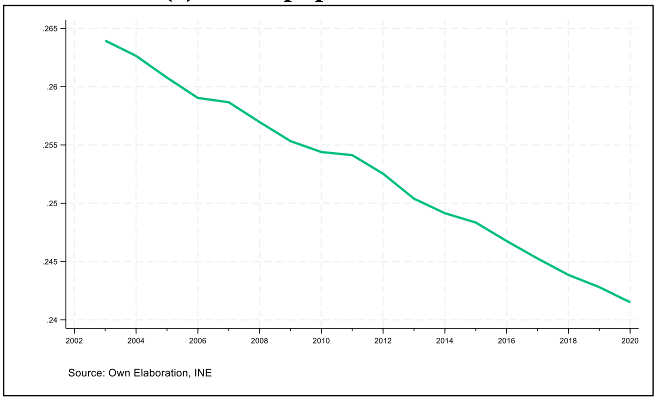
(a) Urban population share



(b) Semi-urban population share



(c) Rural population share



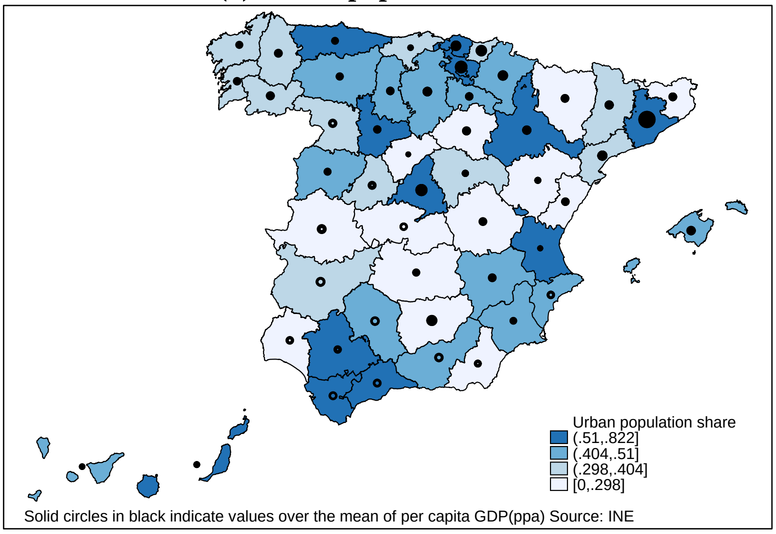
Source: own elaboration

The maps in Figure 3.3 allow us to visualize the shares of urban, intermediate, and rural population for all Spanish provinces in 2020, as quantified in Table 3.2. The provinces with the highest share of urban population are mainly located on the coast, except for Madrid, Araba, and Zaragoza. The same is true for the provinces with the highest share of intermediate population; most are located along the coast or are islands, except for those very close to Madrid, like Toledo, and some like Córdoba or Ciudad Real, whose population is mainly urban or semi-urban, with a very low share of rural population. Huesca, Segovia, and Soria also have a good percentage of semi-urban population, approximately 50%, but the remaining population is rural; they do not have an urban population. Lastly, the provinces classified as rural, except for Lugo, are all located in the interior of the peninsula. They represent only 13% of the Spanish population, and many of their villages are already facing serious depopulation issues.

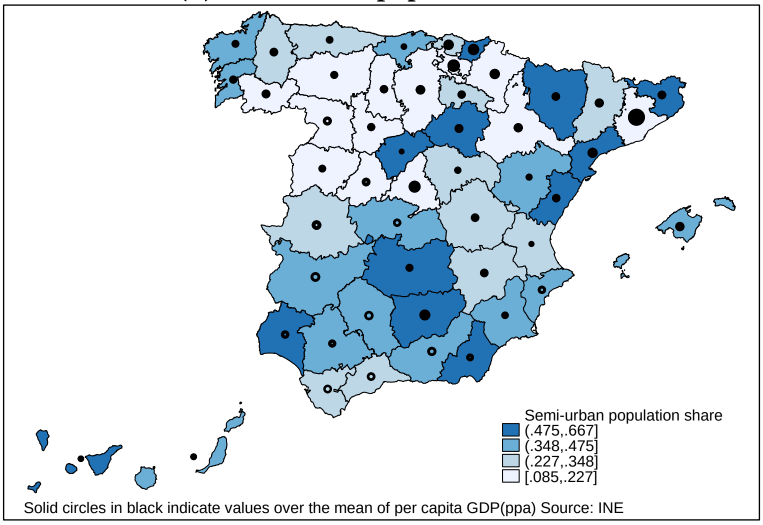
Soria, Teruel, Cuenca, Palencia, Zamora, Huesca, and Ávila form the hard core of depopulated Spain, with population densities, excluding the capitals, below 12.5 inhabitants per km^2. Along with sixteen other provinces, mostly intermediate and some urban, they are characterized by a general reduction in their demographic, labour, and economic weight by almost half since 1950 (Bandrés & Azón, 2021).

Figure 3.3 Distribution of population shares in Spanish provinces, 2020.

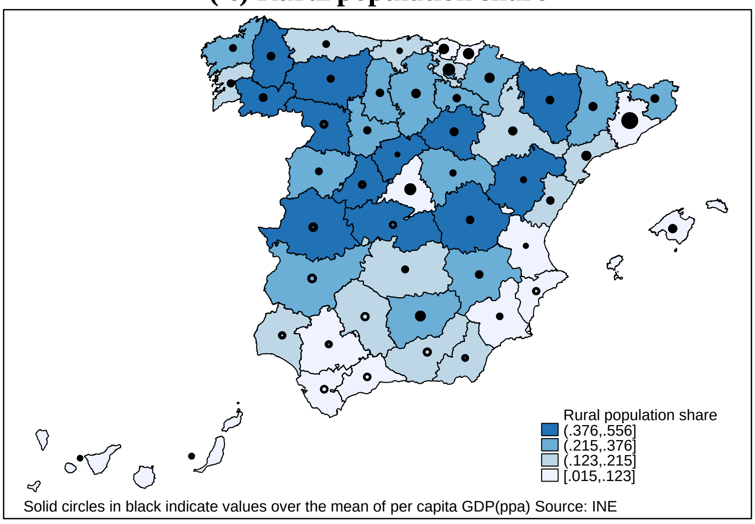
(a) Urban population share



(b) Semi-urban population share



(c) Rural population share



Source: own elaboration

3.4.- Econometric model

The main purpose of this model consists of determining the effect of regional urbanization structure, that is, the distribution of the regional population in the different levels of urbanization, on economic growth. The economic growth has been defined through the regional GDP per capita growth ($\Delta gdppc_{i,t}$) which is the dependent variable. The lagged regional shares of urban and semi-urban population are included as explanatory variables ($shurban_{i,t-1}$ and $shsemi_{i,t-1}$). In the literature, there are studies that include the share of urban population in their models. For example, Brülhart and Sbergami (2009) consider the share of urban population using metrics such as populations exceeding 750 inhabitants, and populations residing in cities, all relative to the country's total population. Nevertheless, the novelty of the present paper is the analysis of the simultaneous effect of urban and semi-urban population shares on the level of development of a regional system.

In addition, to identify the differential economic impact of urban and semi-urban populations on different levels of economic development, we have incorporated an interaction term between population shares and GDP per capita in our model specification $(shurban*gdppc)_{i,t-1}$ and $(shsemi*gdppc)_{i,-1}$. This approach allows us to better understand the relationship between the two types of population and economic growth. It is worth noting that while Williamson's hypothesis considers only the effects of urban population on economic growth, this study adds the effects of semi-urban population on economic growth. To capture the presence of non-linear effects, we also consider square terms of the agglomeration measures ($shurban_{i,t-1}^2$ and $shsemi_{it-1}^2$) (Brülhart and Sbergami, 2009).

Furthermore, we incorporate control variables such as the population over 65 years ($pop65_{i,t}$) and the population between 15 and 65 years ($pop1565_{i,t}$). These variables facilitate the control of both population size and demographic structure within the analysis.

Population diversity plays a significant role in shaping economic development. This importance is particularly pronounced in regions where migration plays a significant role in economic activity. To account for this, we have incorporated an indicator of population diversity, measured using the Alesina index[45] ($alesina_{i,t}$), as a control variable in our analysis. Additionally, we have included several other control variables to capture various aspects of economic growth, such as the share of unemployment ($shunempl_{i,t}$), population density ($densp_{i,t}$), total of employment per capita, and GDP per capita of each region ($gdppc_{i,t-1}$).

Furthermore, we have introduced dummy variables to account for specific regional characteristics. These include whether the region is home to the main city of an Autonomous Community ($maincity_{i,t}$), whether it is bordered by the sea ($border_i$), and whether the region has its own distinct language, such as Catalan, Gallego, or Vasco, in addition to the commonly spoken Spanish language ($language_i$).

In table 3.3 are described a statistical summary with the variables considered in the model.

To estimate our model, we use the Hausman-Taylor (HT) estimator. The HT has a notable advantage over fixed effects estimators as it permits the inclusion of time-invariant variables in a panel setting, such as language, geographical location or political characteristics, which are relevant for our study (Baltagi, Bresson, and Pirotte, 2003). This approach also enables us to introduce several interaction terms to address the varying effects of urbanization levels (proxies by means urban and semi-urban shares) at different levels of economic development. The HT is essentially a hybrid of a fixed effects and a random effects estimator. For time-varying variables, it works similarly to fixed effects models, as it employs the within-transformation of time-varying variables to estimate consistent coefficients. However, unlike the FE model, the HT also estimates coefficients for time-invariant variables. Since the time-invariant variables can be considered exogenous in our case, such as land area, the resulting coefficients are unbiased (Frick and Rodriguez-Pose, 2018a, 2018b). Moreover, since our panel data consists of few time periods, 2003-2020, the Generalized Method of Moments (GMM) approach tends to be unstable.

[45] Alesina, Harnoss and Rapoport (2016) propose an index of "birthplace diversity" that captures the variety of countries of birth represented in a country´s workforce. The index captures both the proportion of foreign-born (size) and immigrant diversity (variety) to empirically analyse the relationship between immigrant birthplace diversity and host country productivity. They find a positive correlation between the two variables, especially strong among high-skilled immigrants in rich countries, suggesting positive effects of diversity (complementarities in skills, cognitive abilities and problem-solving abilities) on the production function. This could be taken into account in the design of immigration policies.

Consequently, the expression to be used is as follow:

$$\Delta gdppc_{i,t} = \alpha + \gamma gdppc_{i,t-1} + \beta_1 shurban_{i,t-1} + \beta_2 shurban^2_{i,t-1} + \beta_3 (shurban * gdppc)_{i,t-1} + \beta_4 shsemi_{it-1} + \beta_5 shsemi^2_{i,t-1} + \beta_6 (shsemi * gdppc)_{i,t-1} + \delta X_{i,t-1} + \vartheta_t + \varepsilon_{i,t} \quad (1)$$

Where, ϑ_t represents the time fixed effects and ε_{it} is the error term.

Table 3.3 Description of variables (average period)

Variables	Description	Mean	St dev	Min	Max
$\Delta gdppc_{i,t}$	growth rate of PPP per capita GDP year t.	0.012	0.070	-0.718	0.777
$gdppc_{i, t-1}$	ln GDP per capita of province I in t-1	23157.38	5175.46	13353.34	57482.17
$shurban_{i, t-1}$	Share of population in urban municipalities in t-1	0.399	0.195	0.000	0.866
$shurban^2_{it-1}$	Square of share of population in urban municipalities in t-1	0.197	0.161	0.000	0.749
(shurban*gdppc)i,t-1	Interaction term: shurban * log (GDP per capita in t-1)	4.003	1.989	0.000	8.795
shsemii,t-1	Share of population in semi-urban municipalities in t-1	0.349	0.144	0.085	0.669
$shsemi^2_{it-1}$	Square of share of population in semi-urban in t-1	0.142	0.106	0.007	0.447
(shsemi*gdppc)i,-1	Interaction term: shsemi * log (GDP per capita in t-1)	3.501	1.445	0.898	6.703
pop1565i,t	share of population between 16 and 64	0.657	0.026	0.102	0.315
$pop65_{i,t}$	Share of population more than 65	0.194	0.042	0.102	0.315
$unemp_{i,t}$	unemployment rate	16.30	7.68	3.03	42.31
$alesina_{i,t}$	Immigrants' diversity indicator	0.012	0.012	0.000	0.061
$shempl_{i,t}$	Total employment /total population	0.401	0.050	0.273	0.900
$densp_{i,t}$	Population density (in logs)	125.54	162.62	8.60	844.63
$maincity_{i,}$	dummy (1 if province contain the capital of Autonomous Community, 0 if not contain)				
$border_i$	dummy (1 if province is in coast, =0 if province is inside)				
$language_i$	dummy (1 if the province has two official languages; =0 if the province does not have two official languages)				

Source: Own Elaboration

Our dataset consists of a panel comprising 50 Spanish provinces, spanning the years 2003 to 2020. Following the approach outlined by Brülhart and Sbergami (2009), we treat variables representing the shares of semi-urban and urban populations as endogenous, including their quadratic forms and interactions with GDP per capita. Similarly, variables related to the economic context, such as the share of unemployment and employment per capita, are treated as endogenous. Additionally, we consider the diversity index and dummy variables capturing the presence of main cities in the regions as endogenous factors. The remaining variables are treated as exogenous.

3.5 Results

3.5.1 General results

The estimations revealing the effects of population urbanization level on economic growth are presented in Table 3.4. As depicted, the population share parameters (both urban and semi-urban) are significant and positive.

Besides, Table 3.4 illustrates that the impact of both urban and semi-urban population shares on economic growth is non-linear, evidenced by the significant parameters. But results differ in the sign of parameter. Thus, the parameter for the square of share of urban population is negative.

Another significant result, consistent with existing literature and analysed in the subsequent section, pertains to the interaction terms between urban and semi-urban population shares and GDP per capita, as illustrated in Table 3.4. In both cases, the parameter is observed to be negative and statistically significant. Both results, the significance of the quadratic terms and the significance of the interaction terms between urban and semi-urban population shares and GDP per capita, will affect the effect of population shares (urban and semi-urban) on economic growth.

Furthermore, the remaining control variables exhibit the expected signs. Regarding population indicators, the Alesina index and those concerning demographic structure show positive parameters, although only the population over 65 years old displays statistical significance. Other population indicators relevant to economic growth that are also statistically significant include population growth and density, although they are negatively related to it. Employment-related variables ($UNEMP_{i,t}$ and $SHEMPL_{i,t}$) reveal statistically significant parameters with expected signs, negative in the former case and positive in the latter. Finally, dummy variables ($BORDER_i$, $LANGUAGE_i$, $MAINCITY_i$) positively influence economic growth, but the latter lacks statistical significance.

Table 3.4 Results estimation

	HAUSMAN-TAYLOR MODEL
$GDPpc_{, t-1}$	-0.29789***
	[0.02645]
$SHURBAN_{i, t-1}$	2.12907***
	[0.57757]
$SQURBAN_{i, t-1}$	-1.11777**
	[0.44090]
$(SHURBAN*GDPPC)_{i, t-1}$	-0.07734**
	[0.03803]
$SHSEMI_{i, t-1}$	0.90142*
	[0.53474]
$SQSEMI_{i, t-1}$	1.52736***
	[0.46704]
$(SHSEMI*GDPPC)_{i, t-1}$	-0.16448***
	[0.04729]
$POP1665_{i, t}$	0.08019
	[0.20954]
$POP65_{i, t}$	1.07481***
	[0.24972]
$UNEMP_{i,t}$	-0.00293***
	[0.00046]
$SHEMPL_{i,t}$	0.65176***
	[0.07525]
$POPGR_{i,t}$	-0.51449***
	[0.02486]
$DENSP_{i,t}$	-0.21426***
	[0.03695]
$ALESINA_{i, t-1}$	0.27515
	[0.36285]
$BORDER_{i}$	0.23709***
	[0.07348]
$LANGUAGE_{i}$	0.37290***
	[0.06791]
$MAINCITY_{i,}$	0.08541
	[0.06055]
CONST	2.85007***
	[0.31300]
Observations	800
Number of groups	50
Wald chi2	6647.42***
Sargan-Hansen	2.132
Regional effects	yes
Time effects	yes

Source: Own Elaboration

3.5.2 Urban and semi-urban population impact on economic development applied to Spanish Regions

From Table 3.4, this Section focuses on the impacts of the population share parameters (both urban and semi-urban) on the Spanish provincial development. Firstly, both are significant and positive, aligning with findings from prior research for the urban case (Brülhart and Sbergami, 2009 and Castells-Quintana and Royuela, 2014), while that, as far as our knowledge extends, the are no similar work analysing the simultaneous influences of the urban and semi-urban shares.

The outcomes showcased in Table 3.4 underscore a noteworthy observation: both the parameters linked with the squared urban population share and the squared semi-urban population share are statistically significant, revealing the nonlinear correlation of these variables with economic growth. Concerning the square of the urban population share, the estimated parameter is significant and negative, as supported by research from Lewis (2014), Arouri et al. (2014), Kolomak (2012), Nguyen (2018), and Brülhart and Sbergami (2009). Conversely, the quadratic representation of the semi-urban population share yields a positive relationship with economic growth.

Furthermore, as discussed in the preceding section, the interaction terms between GDP per capita and each type of population share (urban and semi-urban population shares) also exhibit significant parameters, being both negative.

The examination of the elasticity of economic growth concerning to urban and semi-urban population shares that this research presents would enable a detailed exploration of the distinct patterns associated with these shares and their relationship to economic growth. Thus, by equaling to zero the elasticity function would facilitate the identification of the population (urban and semi-urban) share where the effects on the economic growth changes. The detection of these shares would let establishing the population share threshold (urban or semi-urban) at which agglomeration and/or congestion effects shifts appear. These shares (that we can denote as "thresholds") can be obtained if equations 2 and 3 are equaled to zero. Hence, by optimizing equation 1 respect urban and semi-urban population shares, they are obtained the urban and semi-urban population shares to which economic growth is optimum (given a certain level of GDP per capita for each Spanish province, and ceteris paribus), at which agglomeration or congestion effects start to emerge for the Spanish provinces[46].

To ascertain the elasticity of urban and semi-urban population shares on economic growth, we compute the partial derivative function of equation (1) and substitute the parameters outlined in Table 3.4 to the panel data that comprises the period 2004-2020.

[46] If equations 2 and 3 are equaled to zero, we are maximizing equation 1 respect urban and semi-urban population share, therefore, obtaining the urban and semi-urban Population share to which economic growth is maximun, given GDP pc of each province, ceteris paribus.

Thus, the urban and semi-urban elasticities applied to the Spanish Regions are as follows[47]:

$$\frac{\partial \Delta GDPpc}{\partial shurban_{t-1}} = \hat{\beta}_1 + 2\hat{\beta}_2 shurban_{t-1} + \hat{\beta}_3 log\ (GDPpc_{t-1}) = 2.129 - 2.236\ shurban_{t-1} - 0.077 log\ (GDPpc_{t-1}) \quad (2)$$

$$\frac{\partial \Delta GDPpc}{\partial shsemiurban_{t-1}} = \hat{\beta}_4 + 2\hat{\beta}_5 shsemiurban_{t-1} + \hat{\beta}_6 log\ (GDPpc_{t-1}) = 0.901 + 3.054 shsemi_{t-1} - 0.164 log\ (GDPpc_{t-1}) \quad (3)$$

According to expression (2) and (3), urban (semi-urban) population (share) elasticity of economic growth will depend on two factors: the level of urban (semi-urban) population and the level of GDPpc. The impact of a change in population urbanization structures on economic growth will depend on the stage of economic development of the regions ($GDPpc_{t-1}$), as well as on the population urbanization structure of the region[48].

The above expressions convey three main ideas. First, in the context of a cross-sectional analysis, we observe that the main effects of shurban and shsemi-urban are positive ($\hat{\beta}_1$ and $\hat{\beta}_4$). Second, it is feasible to discern that the interaction with GDP pc is negative. Lastly, the quadratic terms provide different effect depending on the type of agglomeration (urban or semi-urban share). From expression (2) it is possible to observe that the influence of the quadratic term, for the case of urban population share is negative, while for the case of semi-urban population share the parameter is positive (expression 3). This result is new in literature since the role of the semi-urban areas has not been previously tested when analysing the Williamson hypothesis[49].

In addition, as first-order condition of maximization or minimization, equalling to zero equations (2) and (3) allows to determine the urban and semi-urban threshold, at which agglomeration or congestion effects start to manifest for the Spanish provinces, giving a certain GDPpc. Therefore, shurban*, in equation (4) (urban threshold) and semi-urban*, in equation (5) (semi-urban threshold) levels represents the estimated urban and

[47] The econometric specification is detailed in next section, expression (3).

[48] Therefore, expression (2) and (3) determine the change in economic growth if urban (semi-urban) population share change in 1% (ceteris paribus on urban (semi-urban) population share and GDP pc).

[49] This analysis is consistent to Camagni's 2017 study, where the authors examine the productivity trends of cities based on their size. They find that diminishing returns affect economic sectors differently, and the threshold is contingent on the nature of the cities. However, there appears to be a consensus that the productivity trend varies in relation to city size. In smaller to intermediate cities, the productivity trend and its impact on economic growth differ from that of larger urban centers, with smaller cities potentially exhibiting greater efficiency (Camagni et al, 2017).

semi-urban population share at which the elasticity of economic growth reaches zero (GDP pc growth is maximum), given the GDP pc of each region.

$$\frac{\partial \Delta GDPpc}{\partial shurban_{t-1}} = 2.129 - 2 * 1.118\ shurban^{*}{}_{t-1} - 0.077 log\ (GDPpc_{t-1}) = 0$$

$$shurban^{*}{}_{t-1} = \mathbf{0.9521\text{-}0.0344\ log\ (GDPpc_{t\text{-}1})} \qquad (4)$$

$$\frac{\partial \Delta GDPpc}{\partial shsemiurban_{t-1}} = 0.901 + 2 * 1.527 shsemiurban^{*}{}_{t-1} - 0.164 log\ (GDPpc_{t-1}) = 0$$

$$shsemiurban^{*}{}_{t-1} = \mathbf{-0.295 + 0.054}\ \boldsymbol{log\ (GDPpc_{t-1})} \qquad (5)$$

The three dimensions of Figure 3.3 provide a comprehensive analysis of the relationship described by the equations (2) and (4). The X-axis represents the GDP per capita (log scale). The Y-axis illustrates the share of urban population. Lastly, the Z-axis depicts the elasticity of economic growth concerning to urban population share. This multidimensional visualization facilitates an understanding of the interplay between urbanization trends and economic performance across Spanish provinces[50].

Simultaneously, in the figure 3.3 is depicted the equation 4 (red line), that indicates, for every provincial average GDPpc, the estimate levels of urban provincial population share where the economic growth of each province is maximum (on those points, the elasticity of economic growth with respect to urban population is equal to zero).

The figure 3.3 synthesizes one of our main findings: provinces with higher urban population shares are associated with lower elasticities of economic growth with respect to urban population ($\frac{\partial \Delta GDPpc}{\partial shurban_{t-1}}$) that is, the relation between urban population shares and the corresponding elasticities is negative.

To enhance comprehensibility and provide clearer insights into the results, we have illustrated Figure 3.4 from a two-dimensional perspective, utilizing the ZX axes. If a lineal function is fitted[51] to the points, it is possible to determine that, approximately, when the urban share is 0.6, the elasticity reaches zero. Beyond this threshold, if the urban share exceeds 0.6, the contribution of urban population share to economic growth would

[50] In Figure 3.3 the averages of the GDP and the population urban share for the period 2004-2020 were used.
[51] Note: the lineal function fitted is as follows: $\frac{\partial \Delta GDPpc}{\partial shurban_{t-1}} = 1.36 - 2.25 * shurban_{t-1}$

be negative; that is, the elasticity turns negative. This indicates a detrimental effect of urban population share on economic growth.

Figures 3.3 and 3.4 show that provinces as Cádiz, Vizcaya, Zaragoza, Barcelona, Araba, and Madrid present negative elasticities of urban population share on economic growth. Therefore, these provinces face congestion issues, and reducing their urban population would likely improve the effect of urban population share on economic growth. The rest of provinces could increase their urban population share until their urban threshold.

This outcome aligns with research conducted in other European nations by Brulhart and Sbergami (2009), indicating that urban agglomeration promotes economic growth until a specific stage of development, at which point the negative effects of diseconomies begin to hinder further economic progress.

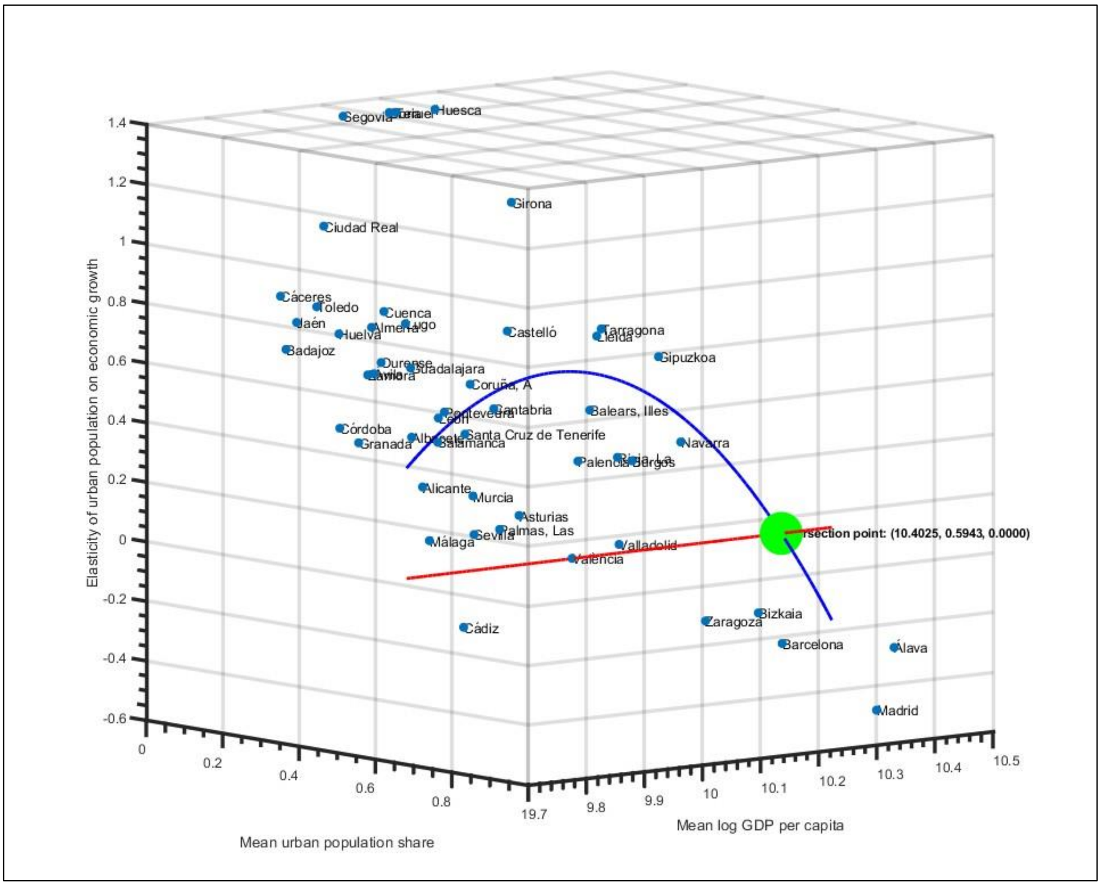
Additionally, figure 3.3 illustrates the relationship between Gross Domestic Product per capita (on a logarithmic scale) represented on the X-axis and the elasticity of economic growth with respect to urban population share shown on the Z-axis. The blue curve in figure 3.3 represents the growth effect of urban population share implied by the Spanish provincial estimation[52]. For enhanced visualization of the ZX plane figure 3.5 presents the two-dimensional graphic.

[52] The fitted function represented corresponds to a quadratic equation with the following form:

$$\frac{\partial \Delta GDPpc}{\partial shurban} = -3.919^{***} \left(log \; (GDPpc_{t-1})\right)^2 + 78.387^{***} \, log \; (GDPpc_{t-1}) - 391.338 = 0$$

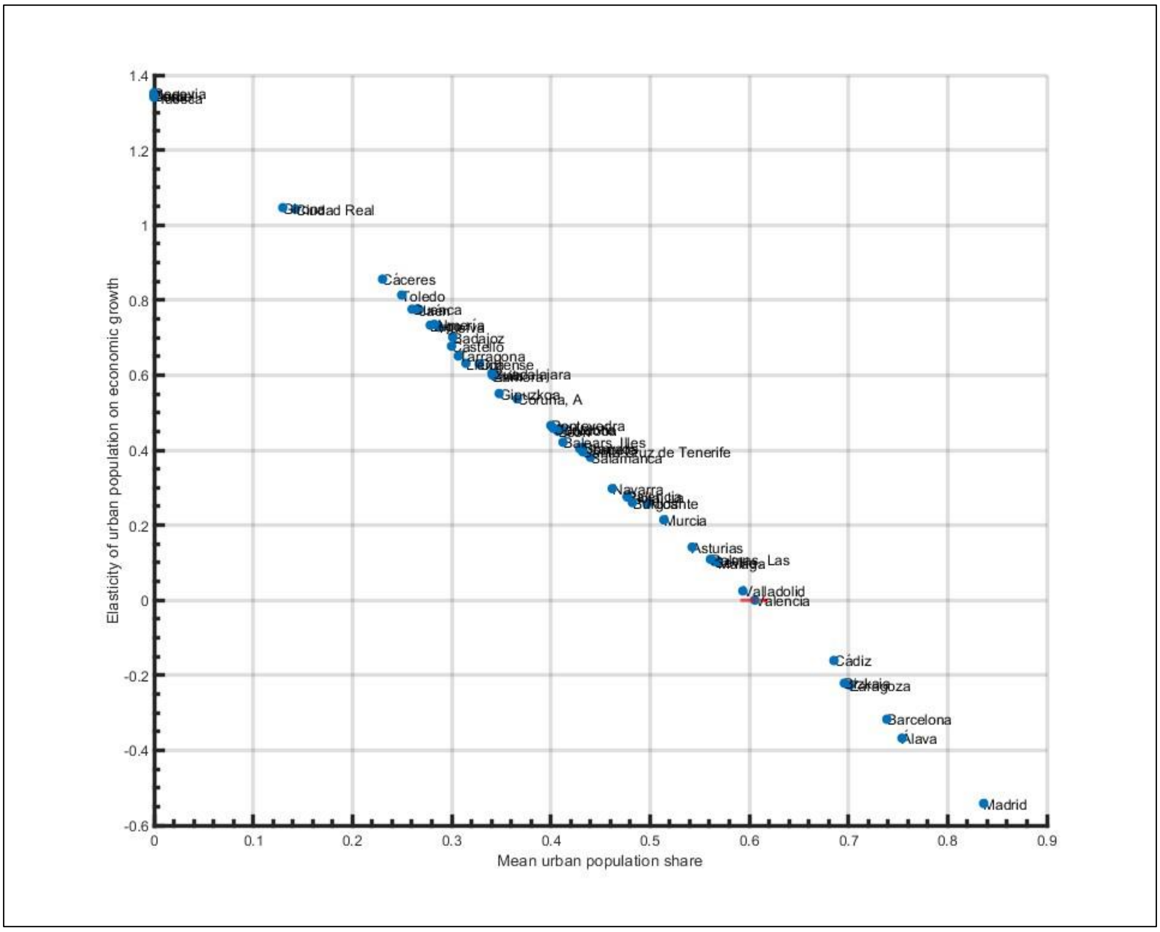
$$R^2 = 0.132$$

Figure 3.4 Elasticity of urban population on economic growth, GDP per capital and urban population.



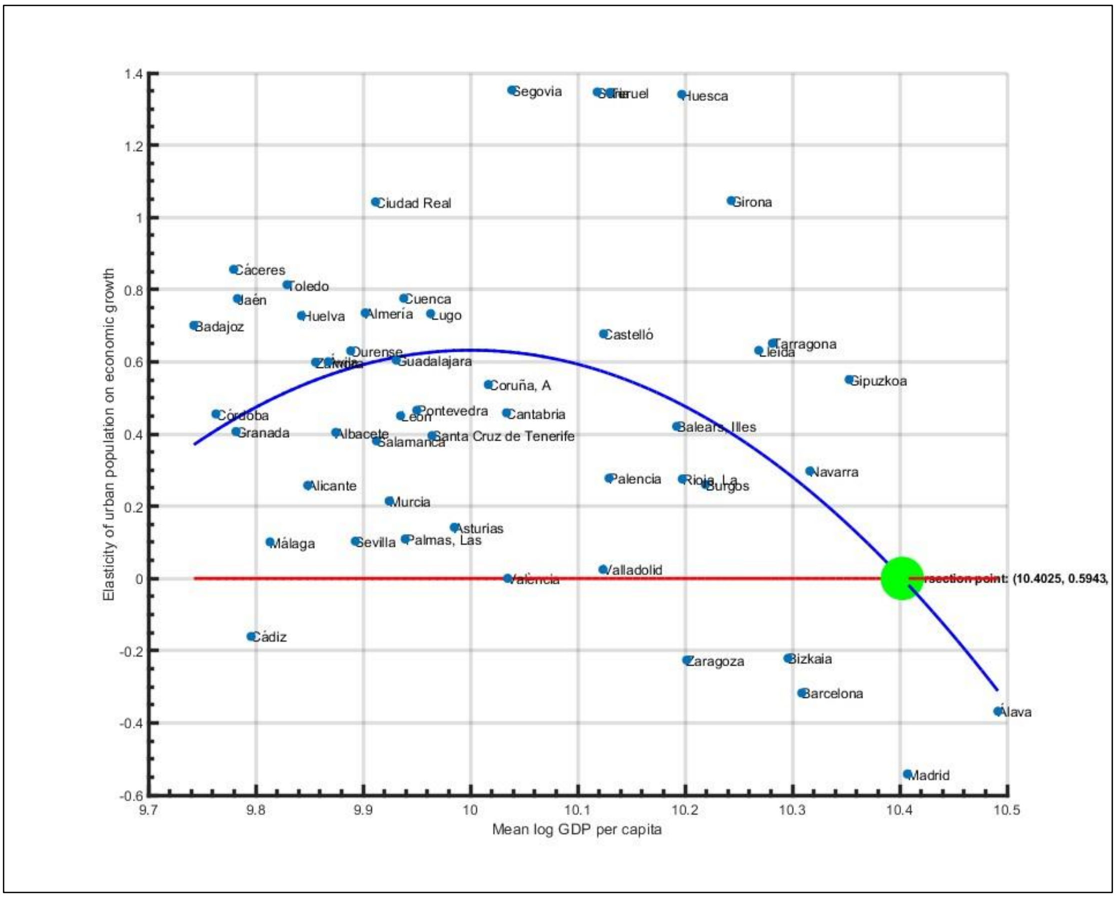
Source: own elaboration

Figure 3.5 Elasticity of urban population on economic growth (Z-axis) and urban population share (Y-axis)



Source: own elaboration

Figure 3.6 Elasticity of urban population on economic growth, GDP per capital and urban population (a different view)



Source: Own elaboration

The inverted U-shaped function fitted to the relationship between elasticity of economic growth and GDP per capita aligns with empirical evaluations of Williamson's hypothesis. This suggests that during the initial stages of development, the influence of urban population share on economic growth intensifies with rising GDP per capita. However, once an economy surpasses a certain level of development, challenges related to congestion emerge, leading to a scenario where an increase in urban population share negatively affects economic growth. Our findings substantiate Williamson's hypothesis, indicating that the impact of urban population on economic growth is more prominent in regions with lower GDP per capita levels. Conversely, it tends to remain neutral or exert negative growth effects in regions with higher GDP per capita levels. Based on our analysis, this turning point is identified at approximately 32859,6 euros (in logarithmic scale, 10,4).

In figure 3.3 and 3.5, we have depicted this point (highlighted in green) where equation (4) intersects with the adjusted quadratic function. This intersection between both, the red and blue lines, signifies the estimated levels of GDP per capita and urban share at which the impact of urban population share on economic development (elasticity) is zero and therefore, the economic growth is maximized.

Summarizing, in the case of urban population share and according to Spanish provinces, the provincial urban structure where the benefits of urban agglomeration are optimal (elasticity of economic growth respect urban population share equal to zero, $\frac{\partial \Delta GDPpc}{\partial shurban}$=0), would be:

- Urban share population: around 0.59 (approximately 0,6).
- GDP pc near 32859,6 (in logarithmic scale 10.4).

For example, looking at the Valencian and Valladolid provinces, the analysis suggests that while the proportion of urban population in Valencia and Valladolid is close to the threshold, their GDP pc is below the optimal level. This could be indicating that there are other socio-economics determinants different of the share of urban population that are affecting the level of development of these provinces.

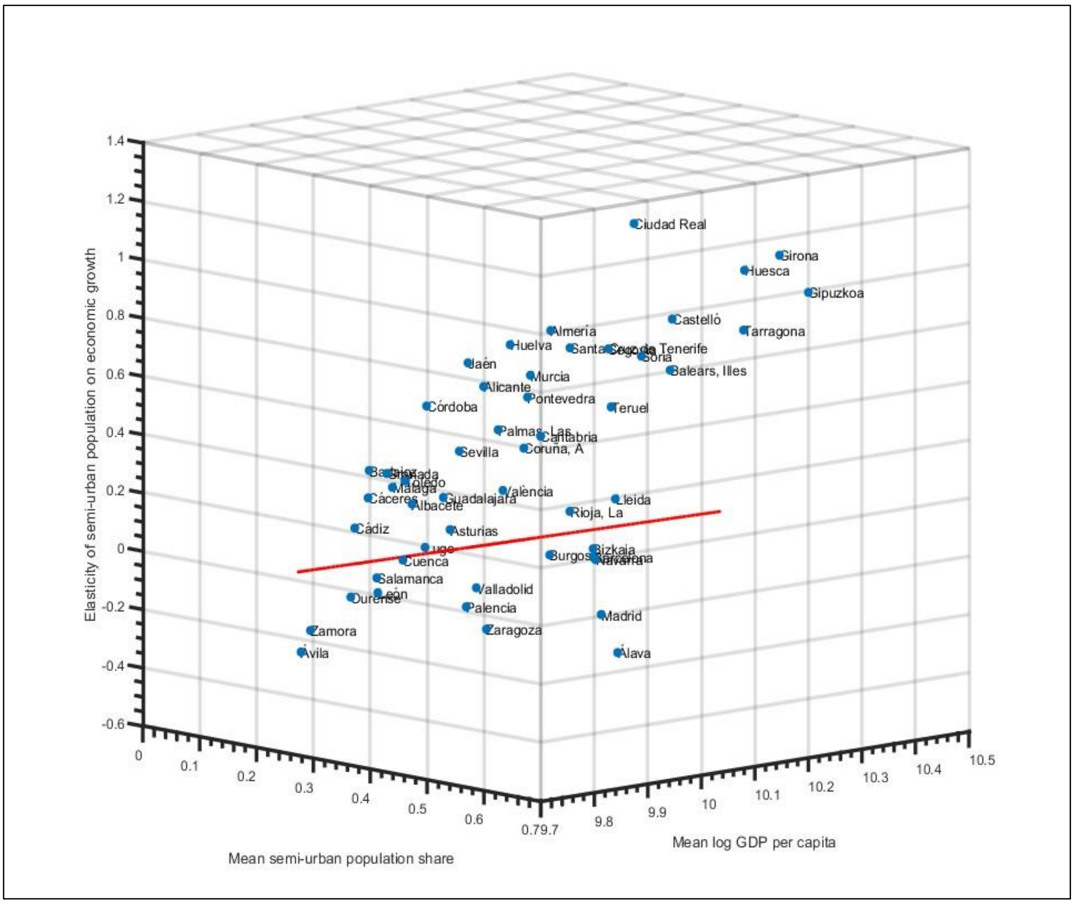
With respect to the semi-urban population share, figure 3.6 displays a three-dimensional graph related with equations (3) and (5). On the X-axis, GDP per capita is presented on a logarithmic scale, while the Y-axis represents the share of semi-urban population. The Z-axis corresponds to the elasticity of economic growth concerning the proportion of semi-urban population. Equation (5) in Figure 3.6 delineates the red line, illustrating the levels of semi-urban population share at which the elasticity of economic growth equals zero for every provincial GDP per capita.

Since the sign of the quadratic form parameter of the variable representing the semi-urban population share is positive ($\hat{\beta}_5$, in equation 3) the relationship between the two variables is positive. To a better visualization, figure 3.7 illustrates the relationship between semi-urban population share (Y-axis) and the elasticity of economic growth with respect to semi-urban population share (Z-axis) from a two-dimension perspective (ZY), therefore, as it is represented, when semi-urban population share increases, the elasticity increases, suggesting the absence of congestion economies. The differences between semi-urban and urban agglomeration are evident in the sense that the relationship between the semi-urban population share and the elasticity of economic growth does not follow the same pattern that the urban population (see figure 3.7 vs figure 3.5).

By fitting a linear function to the data points[53], when the semi-urban population share reaches approximately 0.24, the elasticity approaches zero. Regions with a semi-urban population share below 0.24 exhibit a negative elasticity. By increasing the semi-urban population share beyond 0.24, these regions would enhance the elasticity of economic growth with respect to semi-urban population share of economic growth, consequently fostering economic expansion.

As depicted in Figure 3.6 and 3.7, several provinces such as Araba, Madrid, Zaragoza, Ávila, Zamora, Palencia, Valladolid, Orense, León, Navarra, Barcelona, Vizcaya, Burgos, Salamanca, and Cuenca exhibit negative elasticities. To reverse this trend, these regions should prioritize increasing their semi-urban population shares.

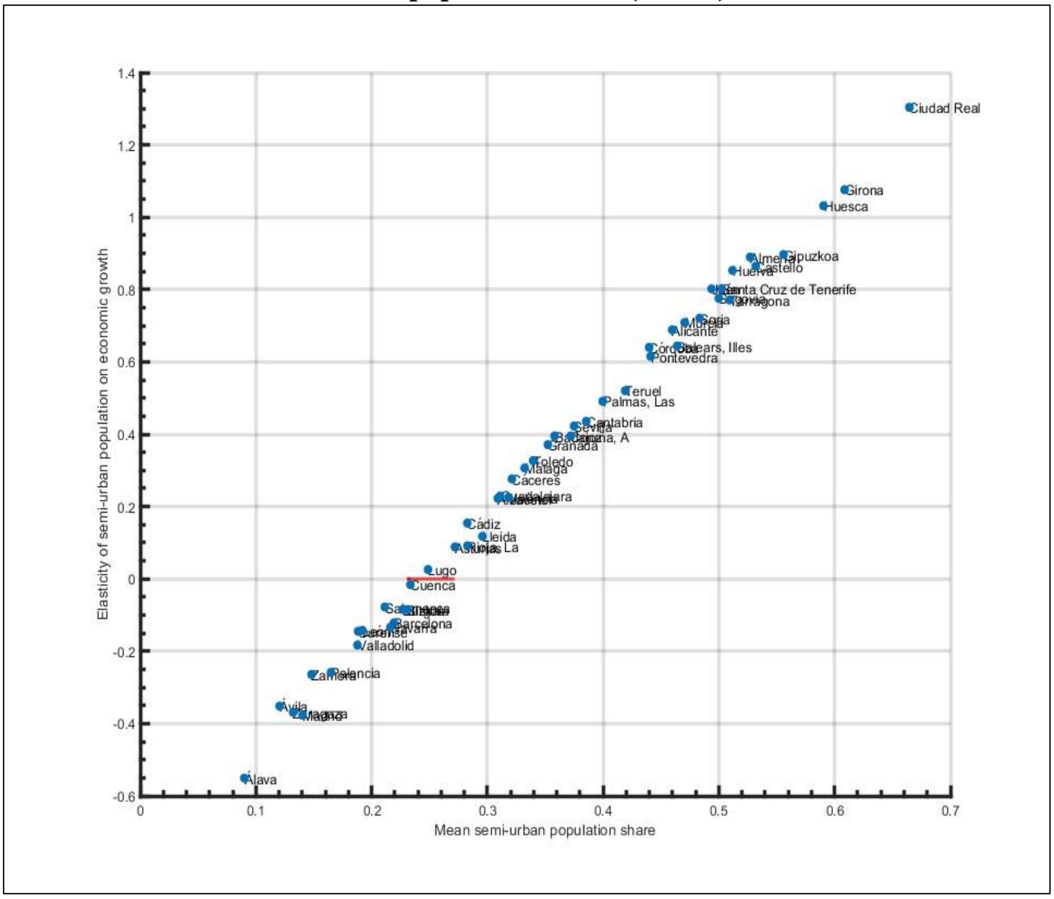
Figure 3.7 Elasticity of urban population on economic growth, GDP per capital and urban population.



Source: Own elaboration

53 $\frac{\partial \Delta GDPpc}{\partial shsemi_{t-1}} = -0.756 + 3.086 * shsemi_{t-1}$

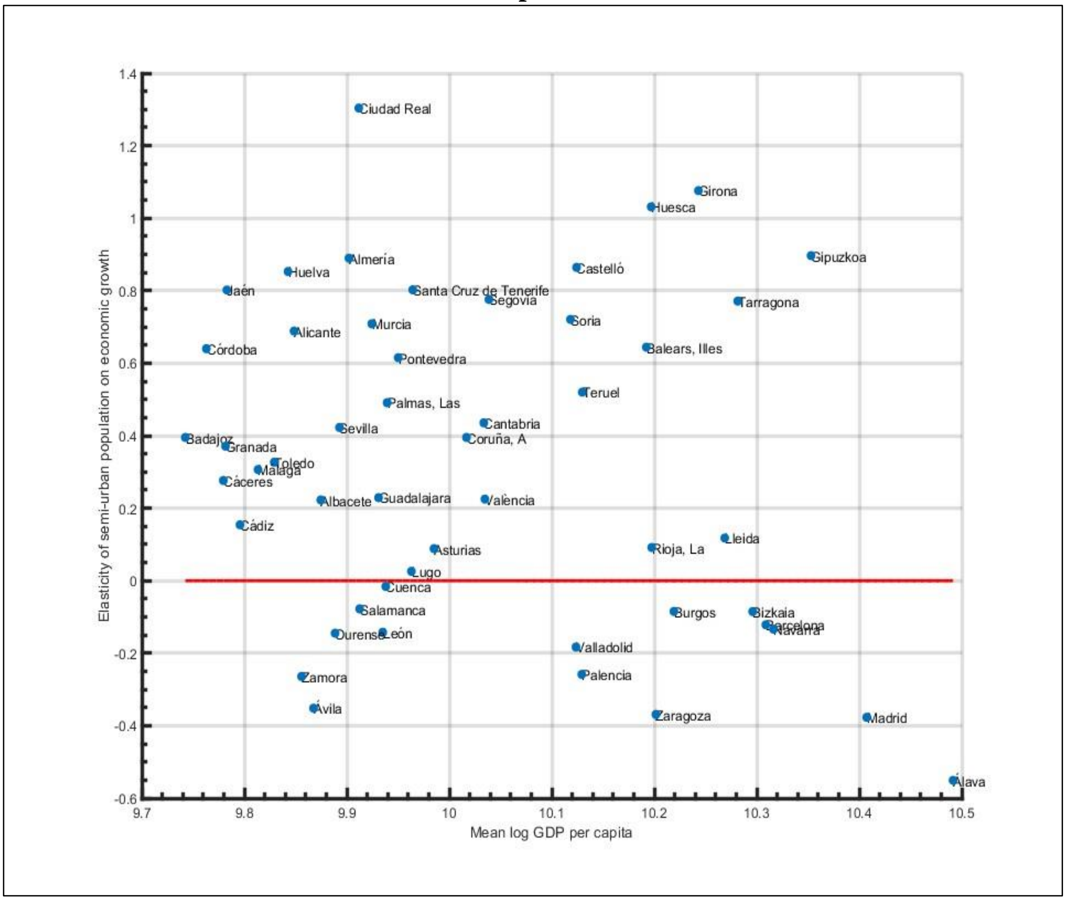
Figure 3.8 Elasticity of semi-urban population on economic growth (Z-axis) and semi-urban population share (Y-axis)



Source: Own elaboration

Figure 3.8 shows a two-dimensional graph depicting the ZX plane, presenting the relationship between Gross Domestic Product (GDP) per capita (logarithmically scaled) on the X-axis and the elasticity of economic growth relative to the semi-urban population share on the Z-axis. Unlike the discernible pattern observed in urban population data, fitting an equation to the scatter points in Figure 3.7 for semi-urban population share proves unfeasible due to the lack of significance in the parameters.

Figure 3.9 Semi-urban population share elasticity of economic growth and GDP per capita.



Source: Own elaboration

Regarding the distribution of semi-urban population across Spanish provinces, our analysis reveals no evidence of congestion economies. Consequently, our findings suggest that a semi-urban population share of at least 0.24 is necessary to prevent the semi-urban population structure from exerting negative effects on economic growth.

Additionally, regarding the level of GDP per capita, the results indicate that the scatter plot formed by Spanish regions does not exhibit a trend consistent with Williamson's hypothesis. Therefore, in the case of semi-urban population, congestion economies do not seem to limit either the economic growth or the economic level of the provinces. These results align with findings from other authors such as Camagni (2017), who have highlighted the higher productivity of medium-sized cities compared to the urban cities of countries.

3.5.- Discussion

Very little was found in the literature on the question of the optimal level of urban and semi-urban concentration within a region. The present study was designed to determine the different role that intermediate municipalities, measured with the total share of semi-urban/intermediate population play respect the urban cities (total share of urban population) on region-level growth.

Considering the Spanish provinces during the period from 2003 to 2020, we have empirically analysed the concentration of their population structures in terms of urbanization levels, focusing mainly on the impacts on economic development. Specifically, our research has examined the distribution of urban and semi-urban population, trying to discern its complex implications for economic development.

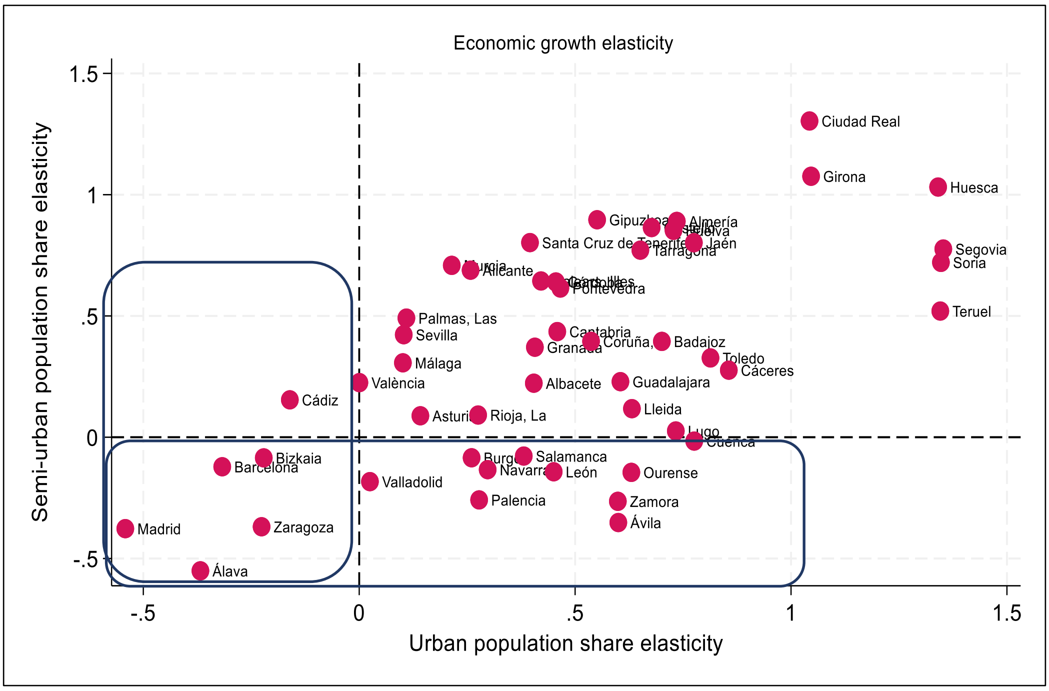
With respect to the first research question, our optimization analysis indicates that, in the case of urban population, it is possible to determine an urban threshold associated with the maximum level of economic development. Beyond this level, further increases or the urban population share leads to a decrease in economic growth, indicating the presence of agglomeration economies. Furthermore, the model estimation has facilitated an examination of the Williamson hypothesis in Spanish provinces. We conclude that the impact of a change in population urbanization structures on economic growth will depend on the stage of economic development of the regions ($GDPpc_{t-1}$). These findings are in line with the existing literature, suggesting that the trajectory of urban agglomerations in Spanish provinces reveals a U-shaped inverted relationship between the elasticity of urban population share on economic growth and GDP per capita. Thus, as the level of economic development ascends, urban agglomeration exerts a diminishing influence on economic growth.

The second research question is concerning to semi-urban population share. In the context of optimization analysis and as opposite to urban population, our result shows that the semi-urban threshold it is an indicator of the minimum share of semi-urban population that the Spanish regions/provinces should have reach in order to obtain increasing economic growth. If semi-urban population share is under this threshold, the economic growth would be decreasing. This result is reveling the absence of congestion economies associated to semi-urban concentration. Regarding Williamson's hypothesis, the results for the semi-urban population share in Spanish provinces do not show an inverted U-shaped relationship between the elasticity of the semi-urban population share and GDP per capita.

It is noteworthy that at threshold levels, the elasticity of economic growth for both urban and semi-urban population share is zero. This result is very relevant as a tool for local and regional development, offering the potential for strategic policymaking aimed at maintaining a balanced distribution between urban and semi-urban populations. Such equilibrium can foster territorial development and enhance overall socioeconomic progress.

Figure 3.9 illustrates the elasticities of the urban and semi-urban population shares corresponding to each province. Notably, four provinces, Madrid, Araba, Barcelona, and Zaragoza, as well as Vizcaya, exhibit negative elasticities in both urban and semi-urban populations.

Figure 3.10 Elasticity of economic growth in relation to urban and semi-urban population.



Source: Own elaboration

This finding suggests that the level of urbanization in these provinces does not foster economic development. As such, policymakers may need to consider implementing measures to promote a more balanced distribution of urban and semi-urban populations in these regions. By doing so, it may be possible to create an environment that is more supportive of economic growth and development in these provinces. The information provided by Figure 3.9 can be used as a tool to design effective policies that aim to achieve a more balanced distribution of the population.

As an example, in the case of Araba, the urban population share is equal to 0.75 (average in period 2003-2020, Annex A), meanwhile, its urban threshold is equal to 0.59 (Annex A). Therefore, and according to expression (4): shurban > $shurban^*$, therefore, if urban population share is reduced below 0.59, urban population share effect on economic growth would become positive.

The semi-urban population share in Alava is 0.09 (average in period 2003-2020, Annex A). However, based on its GDPpc, its semi-urban threshold should be 0.27 (Annex A). Therefore, shsemi-urban < $shsemiurban^*$ (equation 5). If the semi-urban population were to increase beyond 0.27, the resulting structure could generate a positive effect on economic growth and thus improve the development of the region. To achieve this, policymakers may consider implementing policies that encourage the relocation of the population to intermediate settlements. Such a policy may help to promote a more balanced distribution of the population and enable the region to achieve a more optimal semi-urban population share. By doing so, it may be possible to create an environment that is more supportive of economic growth and development in Araba.

On the other end of the spectrum is Girona, exhibiting positive elasticities. In the case of urban population, Girona exhibit an urban share under its threshold (0.12 vs 0.60) (average in period 2003-2020, Annex A). If Girona were to increase its urban population share up to its threshold, the positive elasticity in economic growth would contribute to further enhancing the province's economic growth (the urban population additional would contribute to increase the economic growth).

In relation to semi-urban population share, equal to 0.61 (average in period 2003-2020, Annex A) is over its threshold that is near 0.26 (Annex A); in this case, as semi-urban population has not congestion economies, no action should be taken.

The optimal strategy, in the case of Girona could be to transform rural cities into semi-urban cities and semi-urban cities into urban cities. In this way, the urban share would increase, boosting economic growth. The transformation of semi-urban cities into urban cities would be compensated by the transition from rural to semi-urban areas.

3.6.- Conclusions

This chapter examines the impact of population concentrations in Spanish provinces on economic growth, delimited by different levels of urbanization (rural, semi-urban, urban). Through an exhaustive review of the existing literature, we carry out a two-level research approach. Firstly, we formulate and estimate a model on economic growth, considering as key variables those related with urban and semi-urban effects, while incorporating relevant control variables for robust analysis.

The estimated parameters, allow to perform the second part of our study. We conducted an optimization exercise aimed at discerning the impact of population on economic growth, distinguishing between urban and semi-urban population shares. The aim is to calculate the elasticity of urban (semi-urban) shares on economic growth. Our results show that the type of population shares generates opposite effects on economic growth: while the impact of urban population on economic growth decreases as urban share increases (reflecting diminishing urban effects), the elasticity of the semi-urban population on economic growth increases along with its share. This analysis has revealed certain urban and semi-urban thresholds. The former represents a maximum, suggesting that if the provinces increase their share of urban population, the negative effect on economic growth will lead to a decline in economic growth. In contrast, the semi-urban threshold represents a minimum, indicating that a reduction in the semi-urban population share would cause a decrease in economic growth.

As an extension of the optimization analysis, we explore the relationship between urban (semi-urban) elasticities and GDP per capita, shedding light on the fulfilment of Williamson's hypothesis (as discussed by Brülhart et al. 2009). While the inverted U-function is evident in the case of the urban population share, it is not fulfilled for the semi-urban population share.

From this study, the optimization exercise reveals estimate optimal points (specifically, two points, one for the urban and the other for the semi-urban population) that define an estimate optimal structure for the Spanish regions in terms of rural-urban-intermediate population distribution in relation to economic development.

The main contribution of this study lies in pointing out the distance of the Spanish provinces with respect to these optimal points, providing an understanding of their current positioning in relation to the ideal configuration.

Another relevant finding is the different pattern of urban and semi-urban population share in terms of their contribution to economic growth. The no-congestion economies associated with semi-urban concentration of population and municipalities allows their economic development without facing the challenges typically associated with urbanization, such as traffic congestion and high living costs.

Knowledge of urban and semi-urban thresholds is an important tool for local and regional development because it shows us the contribution of each type of population to regional economic growth. It allows for strategic policies to be developed to preserve a balance between urban and semi-urban populations. This balance can benefit the development of territories.

3.7.- References

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Annex A

	Average in period: 2003-2020						
Province	**Elasticity of urban effect on GDPpc growth**	**Elasticity of semi-urban effect on GDPpc growth**	**Urban population share**	**Semi-urban population share**	**Urban threshold**	**Semi-urban threshold**	**GDPpc (PPA)**
Álava	-0.365	-0.545	0.754	0.090	0.591	0.272	36128.23
Albacete	0.409	0.225	0.429	0.309	0.612	0.238	19535.07
Alicante	0.258	0.689	0.497	0.460	0.613	0.237	18995.68
Almería	0.735	0.887	0.283	0.527	0.611	0.240	20038.11
Ávila	0.606	-0.349	0.341	0.120	0.613	0.238	19379.14
Badajoz	0.705	0.397	0.301	0.358	0.617	0.231	17118.83
Balears, Illes	0.422	0.646	0.412	0.464	0.601	0.255	26797.93
Barcelona	-0.317	-0.120	0.739	0.219	0.597	0.262	30556.3
Burgos	0.264	-0.082	0.482	0.227	0.601	0.257	27539.81
Cáceres	0.861	0.278	0.230	0.321	0.616	0.233	17812.91
Cádiz	-0.158	0.158	0.685	0.283	0.615	0.234	17995.77
Castelló	0.679	0.865	0.300	0.532	0.604	0.252	25063.36
Ciudad Real	1.047	1.305	0.143	0.665	0.611	0.240	20232.49
Córdoba	0.458	0.643	0.411	0.440	0.616	0.232	17443.57
Coruña, A	0.539	0.394	0.366	0.372	0.608	0.246	22530.64
Cuenca	0.782	-0.016	0.260	0.233	0.610	0.242	20853.02
Girona	1.072	1.080	0.120	0.609	0.600	0.258	28127.59
Granada	0.410	0.372	0.432	0.352	0.616	0.233	17777.63
Guadalajara	0.603	0.222	0.341	0.311	0.610	0.241	20612.27
Gipuzkoa	0.554	0.901	0.348	0.556	0.596	0.264	31479.09
Huelva	0.728	0.850	0.288	0.512	0.614	0.237	18886.11
Huesca	1.344	1.032	0.000	0.590	0.601	0.256	26925.74
Jaén	0.778	0.804	0.267	0.494	0.616	0.233	18118.87
León	0.454	-0.142	0.407	0.192	0.610	0.241	20712.77
Lleida	0.635	0.120	0.314	0.296	0.599	0.260	28861.9
Rioja, La	0.277	0.092	0.477	0.283	0.601	0.256	26909.74
Lugo	0.739	0.027	0.278	0.249	0.609	0.243	21410.8
Madrid	-0.543	-0.377	0.836	0.140	0.594	0.267	33227.03
Málaga	0.101	0.306	0.569	0.332	0.615	0.235	18325.51
Murcia	0.216	0.710	0.514	0.470	0.611	0.241	20480.71
Navarra	0.302	-0.131	0.462	0.216	0.597	0.262	30303.68
Ourense	0.634	-0.146	0.328	0.188	0.612	0.239	19865.68
Asturias	0.147	0.094	0.543	0.272	0.609	0.244	21783.52
Palencia	0.282	-0.257	0.477	0.165	0.604	0.252	25196.73
Palmas, Las	0.109	0.491	0.561	0.400	0.610	0.242	20769.5
Pontevedra	0.468	0.616	0.400	0.441	0.610	0.242	21072.92
Salamanca	0.382	-0.079	0.440	0.211	0.611	0.240	20251.91

Santa Cruz de Tenerife	0.395	0.801	0.432	0.502	0.609	0.243	21297.5
Cantabria	0.457	0.432	0.402	0.385	0.607	0.247	22847.59
Segovia	1.356	0.781	0.000	0.500	0.607	0.247	22934.65
Sevilla	0.104	0.424	0.565	0.375	0.612	0.239	19845.78
Soria	1.350	0.718	0.000	0.483	0.604	0.251	24943.33
Tarragona	0.651	0.770	0.307	0.509	0.598	0.260	29268.8
Teruel	1.349	0.519	0.000	0.419	0.604	0.252	25132.46
Toledo	0.814	0.326	0.250	0.340	0.614	0.236	18624.28
València	0.002	0.227	0.606	0.318	0.607	0.247	22856.74
Valladolid	0.022	-0.186	0.594	0.188	0.604	0.252	25030.19
Bizkaia	-0.220	-0.083	0.696	0.231	0.598	0.261	29745.6
Zamora	0.604	-0.263	0.343	0.148	0.613	0.237	19161.21
Zaragoza	-0.225	-0.369	0.701	0.132	0.601	0.256	27060.4

Source: own elaboration

CHAPTER 4. ECONOMIC ACTIVITY AND DEMOGRAPHIC FACTORS IN URBAN, SEMIURBAN AND RURAL PLACES: AN APPLICATION TO THE CASE OF EXTREMADURA (SPAIN)

4.1.- Introduction

In recent years, the concept of "left behind places" has gained prominence among scholars. This term is employed to describe economically disadvantaged and declining regions, with a specific focus on former industrial and marginal rural areas. These trends have been reflected in increased support for populist parties and movements, (Guilluy, 2019; Rodriguez-Pose, 2018). The emergence of these places as hotspots of discontent reflects the increased social and spatial inequalities that have intensified in the first decade of present century following the global financial crisis, particularly in the United States and the United Kingdom. Factors such as economic insecurities, declining living standards, concerns about future prosperity, and cultural resentments have converged, generating a populist criticism against elites and mainstream institutions in Europe and the United States, with significant participation from those in "left behind" communities (Dijkstra et al., 2020; Ford and Goodwin, 2014). In Spain, movements related to the "populism" have arisen mainly in places with high risk of depopulation and lack of economic activity. As a consequence, several political parties have appeared in Spain.

MacKinnon et al (2021) identify characteristics of "left behind places" as a combination of disadvantages as a lack of employment, low levels of educational qualifications, inequalities, demographic shrinkage, scarce connectivity and infrastructure, low levels of public equipment, a lack of civic assets, aging, reduce service provision, (Davenport and Zaranko, 2020; Oberst et al.,2019; Tomaney et al., 2019; Tomaney et al.,2021). The convergence of these dimensions requires a more expansive approach to development conception, as well as an expansion of regional policies that effectively incorporate social, political, environmental, and economic aspects.

The concept of neo-endogenous development is a new framework for local development based on the utilization of internal resources and endogenous factors to foster sustainable economic growth and social progress within a specific region (MacKinnon et al, 2021). It diverges from traditional development models that primarily focus on attracting external investments and resources. Neo-endogenous development recognizes the significance of interterritorial collaboration and acknowledges the importance of establishing a supra-municipal unit that includes neighbouring and similar local entities. This approach emphasizes the need for regional cooperation and coordination to address shared challenges, capitalize on collective resources, and leverage complementary strengths. By fostering collaboration between adjacent local entities, neo-endogenous development aims to enhance regional cohesion, promote synergies, and facilitate joint initiatives that can lead to more sustainable and balanced development outcomes.

In this paper we present an approach addressed to identify the importance of inter-territorial connections as a key strategic tool. We propose that, by taking advantage of the benefits offered by spatial connections, local areas can unlock significant development opportunities. Our approach is centered on two crucial factors that are explicitly included in the concept of "*left behind places*": demography and employment. By considering both aspects, we aim to address more in a broader way the challenges faced by these regions. Demographic dynamics, including population decline, aging, and outmigration, have a direct impact on the labour force and employment opportunities in these areas. Understanding the demographic dynamics allows us to fit our strategies to the specific workforce needs of these communities. Moreover, we recognize the importance of employment as a key driver of development and social inclusion. The lack of job opportunities in "left behind places" often leads to economic stagnation and social inequalities. Our approach aims to identify the strengths and potential sectors in each locality, ensuring that employment initiatives are aligned with resources and capabilities of these areas. Through targeted employment strategies, the main objective is to revive and empower "left behind places," promoting economic activity and improving the quality of life for their residents. By understanding the complexities of the relationship between employment and population, we can design comprehensive interventions that promote inclusion, sustainability, and resilience, ultimately driving the revitalization of these "places left behind."

Similar to other aspects of our society, the phenomenon of depopulation is heavily influenced by economic factors. Factors such as employment opportunities, economic activity, population demographics, industry specialization and its ability to add value, among others, explain a large part of the problems faced by territories nowadays and at the same time are also at the origin of them. The evolution of the productive sectors themselves, as well as population flows, are endogenous elements that help to understand the current situation of many municipalities. As a result, employment and population are crucial variables for understanding the complex connections that underlie the territorial processes of numerous areas.

Within this framework, the social economy sector stands out as a pivotal element in driving local development in areas facing decline. Social Economy, comprising cooperatives, social enterprises, and community-based initiatives, has significant potential to drive economic activity in rural regions, stimulate economic diversification, harness local resources, and create employment opportunities that are tailored to the unique strengths and assets of rural communities[54]. The characteristics of the social economy sector and its ability to be resilient to economic crises, are highlighted through concrete examples and by quantifying the number of workers who retain their jobs in the context of economic crisis. Therefore, both firms and workers belonging to the social economy sector are key factors that contribute to understanding population and employment dynamics in an "left-behind" territory (Monzón and Chaves, (2017).

A territorial area is made up of various administrative units, with municipalities often being the smallest. When conducting regional studies, researchers must carefully select the most appropriate unit of analysis based on their objectives. The global regional system is comprised of countries, regions (NUTS-2), provinces, and municipalities. This hierarchical structure creates a complex system with various levels of government and a heterogeneous territory.

For researchers of regional science, it is essential to recognize this heterogeneity and to deepen the interaction between these administrative units. Understanding the inter-connections of these areas is fundamental to achieve a global understanding of the region as a whole. Within the scope of this study, we have chosen to use the municipalities as the basic unit of analysis. Our examination has focused on population dynamics, investigating whether individuals choose to reside in the places where they work and, conversely, whether firms choose to locate in the areas where people reside. To address

[54] Confederación Empresarial Española de Economía Social (CEPES), https://www.cepes.es/social-econ-what-is&lng=en

these questions, it is essential to consider the distinctive characteristics and development disparities that characterize local territories.

We apply this analysis to the Autonomous Community of Extremadura. The Autonomous Community of Extremadura (Spain) is situated in the southwestern Spain, in the border with Portugal. In the context of Spain, the most part of Extremadura municipalities are characterized as a "left behind place" due to a combination of historical, economic, and sociodemographic factors that have contributed to its relative underdevelopment compared to other regions. However, the territory is not homogeneous and, although many municipalities are in a situation of "left behind place", the geographical situation of the Autonomous Community leads to the fact that the policies applied from higher than local levels have not taken into account this strategic situation (border with Portugal). The strategic location of Extremadura along the border presents unique opportunities and potential advantages that have not been fully capitalized upon.

Population and employment are addressed in this study considering the characteristics of Extremadura's municipalities and trying to adjust in the best way to their problems: depopulation and lack of economic activity. This research studies how the spatial distribution of the employment in Extremadura can affect the intra-regional spatial location of the Extremadurian population, and so affect its territorial development. Thus, by employing a simultaneous equations model with population and employment growth as endogenous variables, our study primarily investigates the inter-territorial dynamics between rural, urban, and semi-urban municipalities. The methodology used is based on the approach proposed in Alamá et al. (2022b). We specifically analyse the spread or backwash effects from urban and semi-urban areas to rural regions. Additionally, our analysis aims to discern the significance of the social economy as a factor contributing to the resilience of population and employment dynamics during economic crisis.

The structure of this chapter is as follows: Section 4.2 explores the literature relevant to Chapter 4, followed by Section 4.3, which presents the data used in this analysis. Section 4.4 outlines the methodology employed in the research, providing an overview of the analytical approaches and tools used. Finally, Sections 4.5 and 4.6 offer a detailed analysis of the results and the conclusions obtained.

4.2.- Background

The interrelationships between rural and urban areas have garnered substantial attention from various researchers over the years. This exploration dates back to the seminal work of Jacobs (1969), who argued that rural areas depend on cities. Theoretical contributions from scholars such as Lucas (1988) and Romer (1994) have examined the impact of the urbanization process on economic growth. Additionally, Krugman (1991) made significant contributions with his center-periphery model.

In addition to these rural-urban dynamics, the relationships between the central areas of large cities and their peripheries have also been a focal point of numerous investigations throughout the last century. Researchers like Kain (1968, 1992), Jencks and Mayer (1990), Holzer (1991), Ihlanfeldt and Sjoquist (1998), Voith (1998), Deitz (1998), and Martin (2001, 2004) have explored the causal relationship between the spatial disconnect of job opportunities and adverse outcomes in minority labour markets, therefore have considered the employment as a variable to explain the inequalities and its relation with the population agglomeration in cities.

The interaction between rural and urban areas can yield positive outcomes for rural or regional development. This phenomenon is well-documented in studies by Rondinelli (1984), Henry et al. (1997), Satterthwaite and Tacoli (2003), and Van Leeuwen (2010), which emphasize the significance of small and medium-sized cities in the regional economies of Europe and the Netherlands. Other research efforts, such as those by Partridge et al. (2007), Partridge and Rickman (2008), investigate the impact of distance on the growth of non-metropolitan areas. Additionally, the analysis of Holl (2018) explores into municipal employment growth patterns both before and after the Great Recession, shedding light on resilience within these areas. More recent research from the last decade, including the works of Bosworth and Venhorst (2018), Gutiérrez et al. (2018) for Spain, and Lavesson (2017) for Sweden, further corroborates the vital role of proximity to large urban areas in fostering rural employment growth.

The literature addressing spread/backwash effects resulting from interterritorial relations across various contexts is extensive and diverse, encompassing works by scholars such as Gaile (1980), Henry et al. (1997), Perroux (1950, 1970), and Richardson (1976). Spread effects are defined as the positive impacts experienced by rural areas due to the growth of neighbouring urban or semi-urban areas. In contrast, backwash effects represent the opposite scenario, involving the outflow of human capital and investment from rural areas, resulting in the growth of urban centers. Nevertheless, achieving a consensus on the dominant effect (spread or backwash) remains challenging, primarily due to its dependence on specific contextual factors (as noted by Henry et al. 1997, 2004), the empirical models employed (Ganning et al. 2013), and the institutional environment (Rodriguez Pose, 2013, and Rodriguez Pose and Ketterer, 2019).

Considering the geographic context where spread/backwash effects have been analysed, insights from Partridge et al. (2007) reveal that in Canada, France (Henry et al., 2001), and OECD countries (Veneri and Ruiz, 2016), the rural-urban distance plays a pivotal role in determining the dominant effect, favoring spread effects in these cases. In China, as highlighted by Chen and Partridge (2013), spread effects take precedence in medium-sized cities, whereas in very large cities, the dominant effect on the surrounding rural regions is the backwash effect.

The connection between population and employment has been extensively explored in specialized literature and the methodologies used in the studies referenced are quite diverse, but there is a shared aspect that stands out in the majority of these studies: the intrinsic, endogenous relationship between population and employment. In regional contexts, the interdependency of population growth and employment opportunities adds complexity to the analysis and necessitates careful consideration when constructing analytical models. Carlino and Mills (1987) introduced a model that examined the factors influencing population and employment changes within a territory. Their model employed a system of two equations, treating both population and employment as endogenous variables, in the sense to determine if the decision to reside in a specific place is before or after the choice of employment. Klaesson and Pettersson (2009), using the analytical framework of the Carlino-Mills (1987) model, study the influence of city size on population and employment dynamics in rural areas. Their results led to the conclusion that the sequence was as follows: jobs follow people.

The Carlino-Mills model has had a substantial influence on the research work of numerous scholars studying into the connection between population dynamics and employment patterns. A notable contribution that has extended his model comes from Boarnet (1994), who focuses on the importance of spatial relationships, especially within the framework of the “labour market zone” concept, which is linked to distance among local areas. Boarnet's research extends the original Carlino and Mills (CM) model by incorporating interterritorial relations and shifting attention to the mobility of both individuals and employment opportunities within the broader labour market zone.

Other authors have extended the original Carlino and Mills' model by introducing additional elements to highlight heterogeneity on population or employment. They extend the two-equation models, adding supplementary equations to account for various aspects of employment. including gender-specific employment (Hoogstra, 2012) or sector-specific employment (De Graaff et al., 2012a 2012b). These scholars often consider if "jobs follow people" or "people follow jobs". For instance, the meta-analysis by Hoogstra, et al. (2017) leans more towards the first perspective, a conclusion shaped by the regional characteristics of the spatial unit of analysis chosen in their works. Zhang and Guldmann (2010) consider the heterogeneity in the population equation, introducing inter and intra-ethnic relations of the population.

The diversity of the surrounding regions performs a significant role in many studies. Feser and Isserman (2006) conducted an analysis of the spatial interaction between population and employment, paying particular attention to territorial variation and local neighbourhoods. Their study made a clear distinction between urban, intermediate, and rural areas, which allowed them to explore the repercussions of employment growth from one region to another. Additionally, they dissected the labour market area to examine how employment impacts not only in the immediate environment, but also neighbouring areas, all while taking into consideration the complex web of territorial diversity.

The exploration of heterogeneity in both employment and geographic context has been somewhat limited in the existing literature. The work of Alamá et al. (2022a) defines the CM model considering the diversity of regions (rural, urban and semi-urban areas) and employment sectors (agriculture, industry, services and construction). In this study, the researchers also delve into the spatial interconnections between municipalities, thus accounting for the complexities of local employment dynamics.

Following the Eurostat DEGURBA classification, this chapter takes into account, three types of municipalities: urban, semi-urban and rural, depending on whether they are densely populated areas, with an intermediate population density or sparsely populated[55]. This triple classification will be considered when analysing the relations between population and employment and their effects on the proposed extended Carlino and Mills model.

Taking the territorial development of municipalities as a starting point, this paper analyses the relationship between population growth and employment among the municipalities that are part of each local employment system. The variations in employment and population of a given municipality will be influenced by both the population and employment flows of the municipality itself and of the surrounding municipalities, distinguishing between own effects and spillovers effects (but this paper also distinguishes between the level of urbanization of the municipalities). Not all municipalities generate the same spillover effects; the magnitude of spillover effects will be conditioned by the level of development of the municipalities, and therefore their level of urbanization. Hence, the idea of supra-municipality and the concept of local labour market deserves special attention for its implications in relation to territorial development. The objective is to identify the intermunicipal relationships that contribute most to the development of territories and, therefore, this type of analysis will allow us to focus the study on rural areas and to detect to what extent proximity to urban and semi-urban centers can contribute to modifying the dynamics, both population and economic, of areas in decline.

4.3.- The Social Economy in the context of the regions

A distinctive facet of this research lies in its incorporation of the social economy as a potential determinant of population growth and employment, recognizing the consequential impact on economic activity precipitated by this distinctive economic paradigm.

The European Economic and Social Committee defines the social economy as is proposed by EESC/CIRIEC (2012, p. 22): "*The set of private, formally-organised enterprises, with autonomy of decision and freedom of membership, created to meet their*

[55] Densely populated areas: at least 50% living in high-density clusters. Intermediate density areas: less than 50% of the population living in rural grid cells and less than 50% living in a high-density cluster. Thinly populated areas: more than 50% of the population living in rural grid cells.

members' needs through the market by producing goods and providing services, insurance and finance, where decision-making and any distribution of profits or surpluses among the members are not directly linked to the capital or fees contributed by each member, each of whom has one vote, or at all events take place through democratic and participative decision-making processes. The social economy also includes private, formally organised organisations with autonomy of decision and freedom of membership that produce non-market services for households and whose surpluses, if any, cannot be appropriated by the economic agents that create, control or finance them."

Moreover, the extant literature underscores a pivotal attribute, particularly within the prevailing institutional framework: localized development and sustainability. A substantial proportion of social enterprises originates within specific geographic confines and emerges from the collective initiatives of individuals with discernible needs, leveraging endogenous resources. Social economy is based on the principles of economic development, respect for the environment, and commitment to social cohesion, being a pioneer in the practice of social responsibility.

In recent years, rural areas have gained prominence in scholarly investigations concerning regional economy and territorial development. The decline of economic activity, insufficient service provision, accessibility challenges, and inadequate public infrastructure contribute to the persistent depopulation of these regions. This demographic shift, though not novel, has its roots in the mid-twentieth century, when inhabitants migrated from inland towns to urban centers in search of industrial employment opportunities. mid-twentieth century.

Strategies deployed in the late 20th century and still relevant today emphasize the consideration of territory and local development policies as pivotal drivers of advancement (Vázquez, 2009; Rodríguez-Cohard, 2009), with a pronounced involvement of social economy entities. Recognizing the heterogeneity of territories, effective policies are contingent upon the delineation of their productive structures, labour markets, entrepreneurial landscapes, regulatory frameworks, institutional configurations, and available capital (Gertler, 2010). A judicious organization of these elements throughout the transformation process is imperative (Alburquerque, 1997; Vázquez-Barquero, 2007).

Rodríguez-Pose and Palavicini-Corona (2013) underscore the critical role of institutions in fostering citizen participation, a phenomenon intricately linked to the economic and social well-being of municipalities. Social economy enterprises assume a fundamental role in this context, owing to their democratic structure (Bauer et al., 2012) and territorial ties (Nilsson et al., 2012), functioning as veritable agents of development. They facilitate job creation, promote economic, social, and territorial cohesion, anchor populations to specific territories, stimulate citizen participation, and contribute to sustainable development (Juste et al., 2011; Mozas and Bernal, 2006; Williamson et al., 2003).

In the realm of stable and quality employment creation, Perotin (2013), Díaz and Marcuello (2010), and Calderón and Calderón (2012) underscore the significance of cooperative societies, particularly those of associated work (Perotin, 2013). Such entities provide robust, enduring, sustainable, and locally-rooted employment opportunities that positively impact the economies and public finances of their communities. Cooperative societies, as posited by Díaz and Marcuello (2010), offer higher quality employment characterized by superior working conditions and a reduced risk of dismissal, as they are less susceptible to economic downturns compared to other business models. Calderón and Calderón (2012) corroborate that the impact of the Great Crisis on the employment landscape of social economy entities has been mitigated compared to the broader Spanish economy, primarily due to the superior employment quality intrinsic to these entities, manifested through heightened worker co-responsibility in decision-making, greater internal employment flexibility, and pronounced efforts in socio-labour insertion.

Birchall and Ketilson (2009) accentuate the virtues of the characteristics exhibited by social economy entities, positioning them as instrumental in the recuperation of companies during times of crisis.

The entities within the social economy, characterized by their distinct features and guiding principles, play a pivotal role in fostering sustainable development (an imperative in our contemporary era) and serve as foundational elements in local development strategies (Poyatos and Gámez, 2009; Mozas and Bernal, 2006). Their economic efforts directed towards environmental sustainability not only generate economic prosperity but also contribute significantly to the trinity of economic, social, and environmental cohesion (Carrasco, 2007; Brave, 2019; Carchano and Carrasco, 2020), serving as cornerstone elements for anchoring populations to specific territories.

Carchano et al. (2021) underscore the significance of credit cooperatives in this domain, particularly within regions experiencing the decline of financial institutions and depopulation trends. Despite their potentially lower profitability, the focus of these cooperatives on serving their local environments elevates their role as vital drivers of regional dynamism.

Once we comprehend the attributes of these institutions, an inquiry naturally arises: What impacts does the social economy impart on territorial development? Addressing this query, Carchano et al. (2021) propose two hypotheses concerning the influence of social economy institutions on endogenous development and population density. The first hypothesis scrutinizes whether a higher prevalence of these entities within a region fosters the retention of the population in that area. The second hypothesis investigates whether this augmented presence correlates with increased vegetative growth and heightened population levels. Through the utilization of a partial least squares model encompassing municipal data across 21 variables during 2017 and 2018, both hypotheses find affirmation, revealing that these institutions serve as catalysts in mobilizing local productive resources. This, in turn, augments economic activities and cultivates the generation of stable, high-quality employment opportunities, thereby contributing to the consolidation of population within the territory and fortifying its resilience for growth.

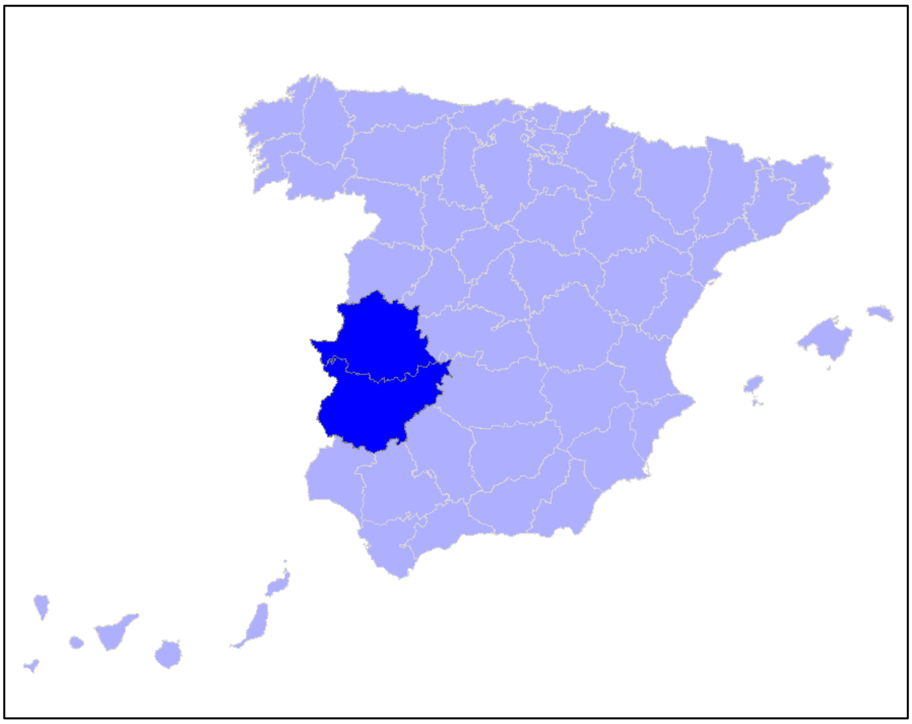
Our paper shows empirical evidence about the influence of the presence of the social economy on both population and employment growth, highlighting their role in combating regional depopulation. The main contribution of this chapter is the simultaneous analysis of the interaction between employment growth and municipal population growth, taking into account the presence of the social economy in the municipalities of a regional economy.

4.4.- Data and Variables

4.4.1 Contextualization

In this section, we present the socio-economic situation of Extremadura during the period 2000-2021. However, before addressing the analysis of the indicators, it is necessary to point out some territorial aspects that influence its economic progress. As detailed by Ramajo and Márquez (2018), beyond its physical limitations such as its geographical location (Figure 4.1), being an inland and border region, or the fact that 31.35% of its territory is designated as protected areas[56], Extremadura is predominantly surrounded by regions with low-income levels, which could be affecting its economic convergence with other regions.

Figure 4.1 Spanish map at province level (NUTS-3)



Source: Own elaboration

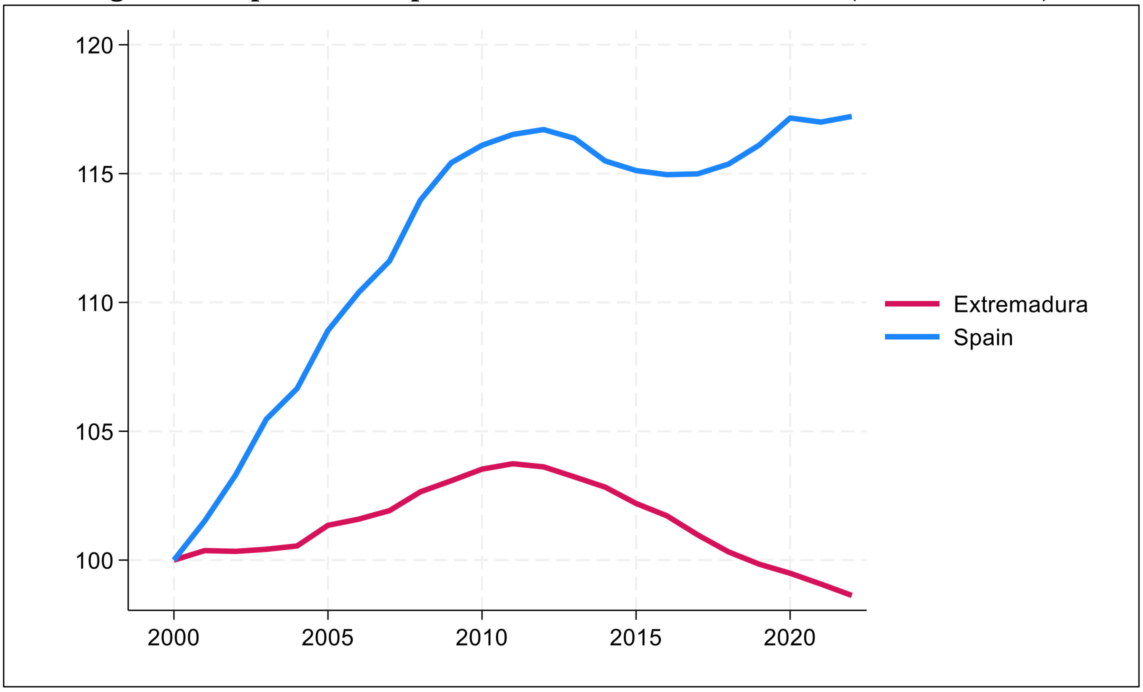
As the fifth-largest autonomous community in Spain, covering an area of 41,633 Km^2, Extremadura is inhabited by 1,054,776 people as of 2022, with a population density

[56] The Official Journal of Extremadura of 11 June 2012 states that the Natura Network in Extremadura is made up of 1,305,608 hectares where biodiversity must be conserved, for which it has Special Areas of Conservation (SAC) in which the long-term survival of species and habitat types in Europe must be ensured.

of 25 inhabitants per Km^2, constituting 2.2% of the Spanish population (National Institute of Statistics, 2022)[57]. According to Berrocal (2018), Extremadura has always been a sparsely populated region, and its territorial representation in the country has always been greater than its population. The region experienced its highest population count in 1960, with approximately 1,374,000 individuals; however, since then, rural migration initiated a demographic decline.

At the outset of the period in 2000, Extremadura's population averaged 1,069,420, gradually increasing to a peak of 1,109,367 in 2011. Subsequently, a steady decline set in, reaching its minimum in 2022 with 1,054,776 inhabitants—data worse than those recorded in the year 2000. While Spain exhibits a primarily upward trend in population, Extremadura experienced growth until the end of 2011, after which a declining pattern emerged, as illustrated in figure 4.2. In relative terms, figure 4.3 depicts the decreasing trend of the Extremadura population as a percentage of the national total, dropping from 2.6% in 2000 to 2.2% in 2022.

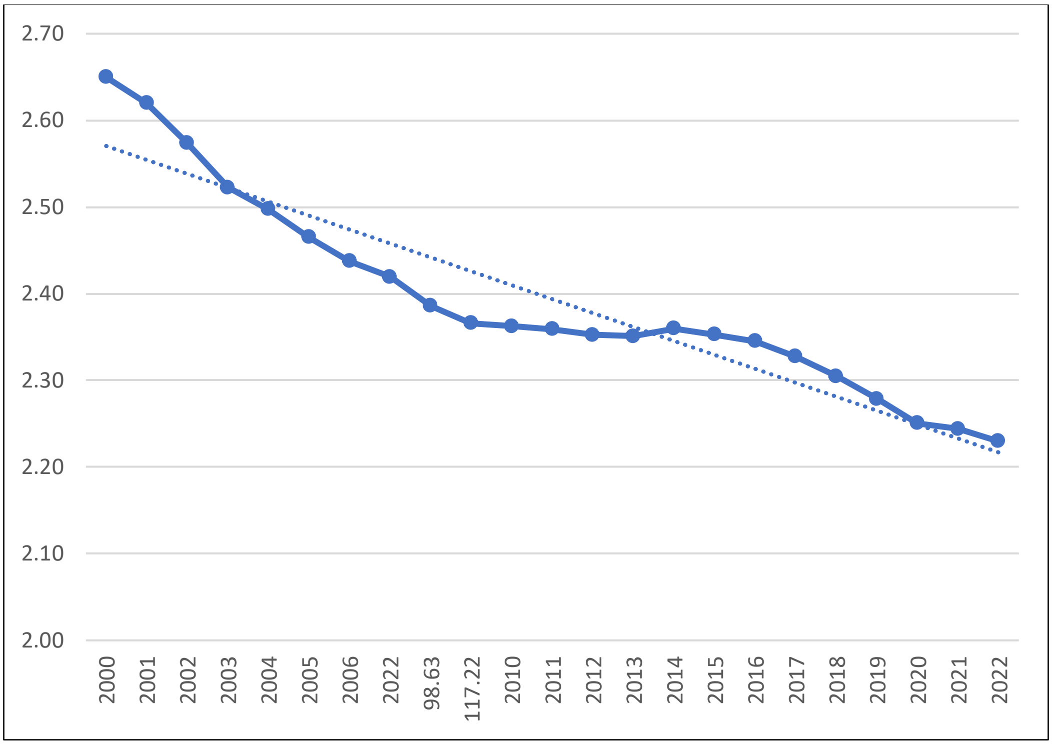
Figure 4.2 Population in Spain and Extremadura, 2000-2022 (Base 2000=100)



Source: Own elaboration

[57] INE, 2022. Continuous census statistics.

Figure 4.3 Population in Spain and Extremadura



Source: Own elaboration

Nowadays, more than half of the population of Extremadura lives in fifteen municipalities, 545,132 inhabitants out of a total of 1,054,776. This group is made up of: Badajoz, Cáceres, Mérida, Plasencia, Don Benito, Almendralejo, Villanueva de la Serena, Navalmoral de la Mata, Zafra, Montijo, Villafranca de los Barros, Coria, Olivenza, Miajadas and Jerez de los Caballeros (Instituto Nacional de Estadística, 2022).

The decreases in the population of Extremadura do not end in 2022. According to the Spanish National Institute of Statistics, the population in both provinces of Extremadura will continue to fall steadily. In the province of Badajoz, the population will drop from 667,000 people in 2022 to approximately 643,849, which represents a reduction of more than 3,5% in 14 years. In Cáceres, the trend is similar, going from 386,302 to 366,490 people from 2022 to 2035 (more than 5% of the population). This situation is even more worrying if we observe that the population projection at national level up to 2037 follows an upward trend, increasing more than four million inhabitants (9% increase of the population) in the 14 years studied.

To analyse the components of population growth since 2000, we examine both natural growth and migration patterns. Demographic indicators reveal low birth and mortality rates, an aging population, and negative natural growth in recent years nationwide, aggravated by the impact of the COVID-19 pandemic in 2020, resulting in demographic stagnation. According to the Statistical Institute of Extremadura, in 2022, 6,872 births occurred, contrasted with 12,262 deaths. The most populous age group ranges from 20 to 64 years (constituting 60% of the population), while the remaining age groups (under 20 and over 65) each account for approximately 20%. Berrocal et al. (2016) present a retrospective analysis of the demographic weakness of Extremadura, highlighting the continuous loss of population, aging, and the breakdown of natural growth.

Migration movements constitute a significant component of population growth dynamics. In Spain, it was the main cause of the increase in the young population (aged 20 to 45) in the 2000s. Mainly coming from Morocco, Latin America, and Sub-Saharan Africa, they were seeking employment and better living conditions, settling in major Spanish cities and Mediterranean regions. Spain surpassed France and the United Kingdom in terms of the percentage of foreign population, reaching 15.8% in 2022. It is essential to underline the interdependency of migration balances with the nation's economic health. The first decade of the 21st century witnessed Spain's robust economic growth, surpassing numerous neighbouring nations, leading to a massive influx of immigrants. However, the 2008 economic crisis resulted in negative migration rates in subsequent years. Presently, following a substantial reduction due to the pandemic, the positive migration balance aligns with the EU-27 average and remains a pivotal factor driving population growth.

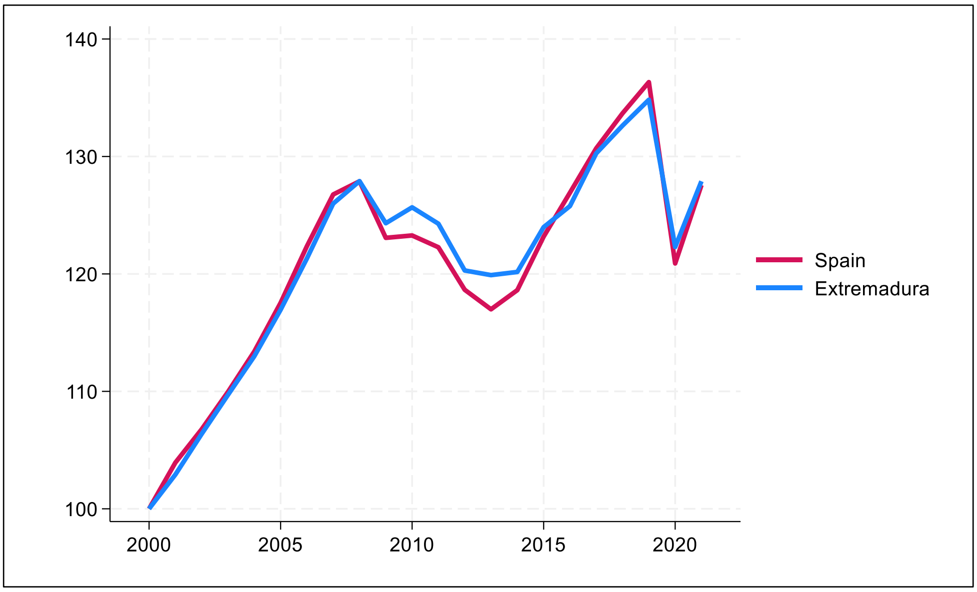
In Extremadura, according to Berrocal (2018), migration patterns have intertwined in recent decades, aggravated by the economic crisis. Consequently, the regional population has experienced a parallel flow of migration, both inbound and outbound, similar to the foreign population, resulting in a perplexing scenario marked by increased arrivals and departures and a dual rural-urban migration direction. Berrocal attributes this complexity to the prevailing demographic and structural characteristics, namely, agricultural dependence and limited industrial presence, which exacerbate the situation.

Furthermore, despite the demographic shifts observed at the national and regional levels, these changes have not occurred uniformly across all territories. Rural areas, characterized by higher aging rates and sharper declines in birth rates, have encountered substantial population losses compared to cities, which exhibit a more favorable natural growth rate (Pérez, 2019).

To analyse the economic context of this research, the Extremadura scenario will be compared with the national context from 2000 to 2022, employing Gross Domestic Product (GDP) as the metric, both in absolute terms and per capita. Noteworthy events in Spain's economic trajectory during these two decades include robust growth until the 2008 Great Recession, followed by recovery in 2017, and the global COVID-19 pandemic, which introduced another recessionary period in the country, gradually recovering from mid-2021. To maintain data uniformity, the study utilizes the regional database BD. MORES base 2015, widely accepted in regional research.

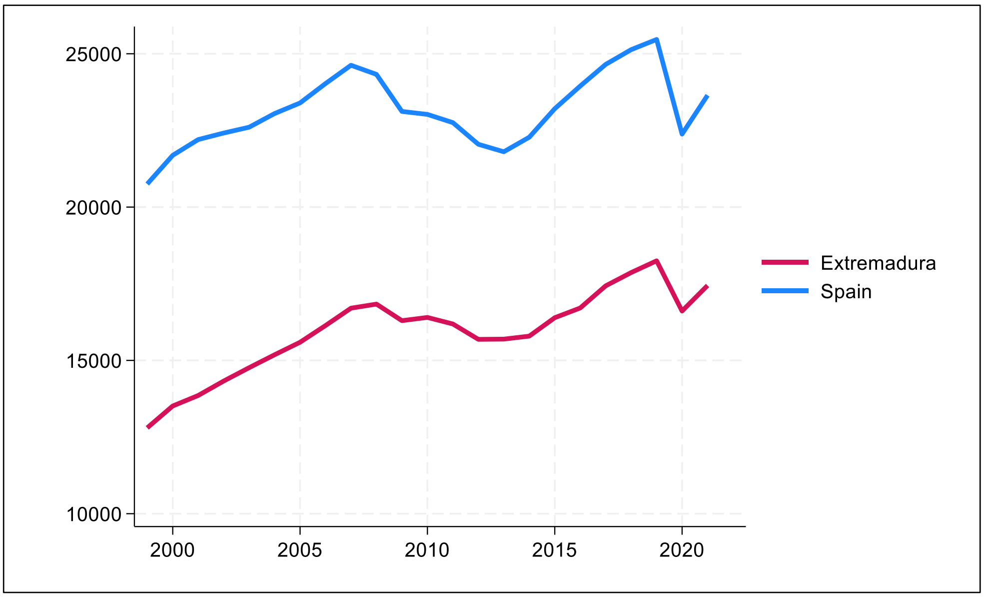
Figure 4.4 illustrates the evolution of GDP at market prices in Extremadura and Spain, denominated in constant 2015 values, adjusted according to the valuation criteria outlined in SEC 2010. Extremadura ranked 15th in 2021, reporting a GDP of 18,480,840 euros. Cumulative average growth rates indicate comparable GDP growth at market prices in both contexts, at 1.18% in Extremadura and 1.17% in Spain. However, when analysed on a per capita basis, Extremadura exhibits the lowest income per person, standing at 17,443 euros compared to the Spanish average of 23,647 euros per person. Although the income disparity is evident, as depicted in figure 4.4, in relative terms, it is discernible that progress has been made over the entire study period, increasing from representing 62.52% of the national average in 2000 to 74% in 2021.

Figure 4.4 Gross Domestic Product. Extremadura and Spain, 2000-2022. (Base 2000=100)



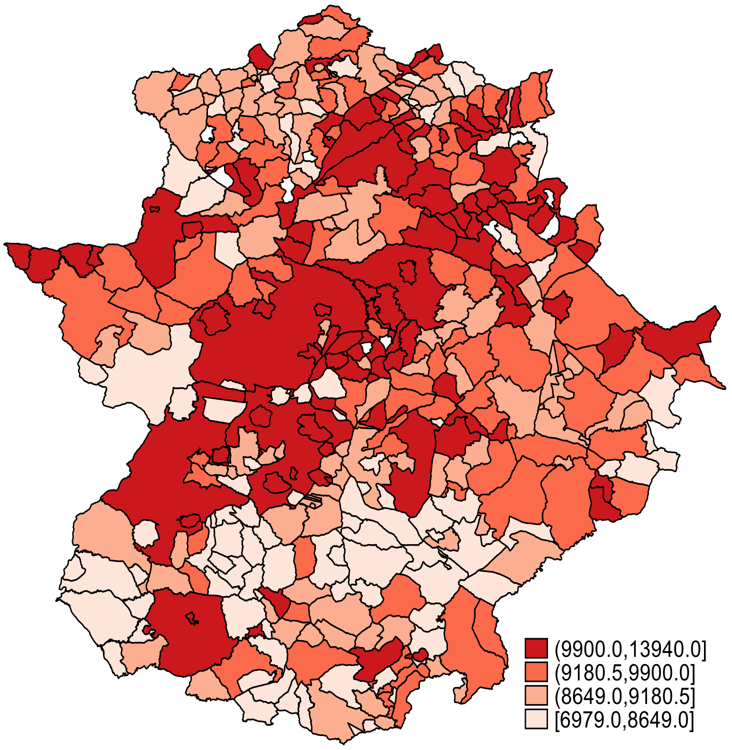
Source: own elaboration

Figure 4.5 Gross Domestic Product, per capita. Extremadura and Spain, 2000-2021



Source: Own elaboration

Figure 4.6 Income per capita, 2019.



Source: Own elaboration

4.3.2 Social economy in Extremadura

In Spain, 80% of municipalities with populations below 5,000 have witnessed demographic declines over the past decade. This phenomenon is not unique to Spain; several other countries, including Poland, Russia, Japan, the USA, Italy, Germany, and Greece, grapple with similar challenges (Carchano et al., 2021).

In Extremadura, like in other inland regions of our peninsula, depopulation of rural areas is becoming increasingly significant. The problem, far from being resolved, will worsen in the future as indicated by the latest population projections published by the INE and discussed at the beginning of this section. The main demographic indicators show worse outcomes in these rural areas compared to urban and intermediate areas, characterized by higher rates of aging, low population density, and negative natural and migratory balance. Other characteristics of rural areas include a male-dominated population and a lack of job opportunities.

In the context outlined, in addition to governmental interventions at the state and regional levels, social economy institutions possess the potential to mitigate depopulation trends by serving as conduits for comprehensive local development across various dimensions, encompassing economic, social, cultural, and environmental domains. This multifaceted approach facilitates the establishment of sustainable settlements within the region (Castro et al., 2013; Carchano and Carrasco, 2020).

Next, we will review the main figures of the social economy in Extremadura and compare them with those of the Spanish territory to understand the significance of its performance in our community. According to the White Paper on Social Economy in Extremadura in 2023, based on statistics from CIRIEC-Spain, there were 2,387 entities from different social economy sectors in Extremadura in 2019. These entities provided direct employment to 20,736 workers (5.44% of total employment) and generated a turnover of 2,511 million euros (12.24% of Extremadura's total GDP). In Spain, the percentage of employees in the social economy relative to total employment is higher than in Extremadura (6.75%). However, the net turnover of the social economy concerning the total volume is lower than in Extremadura (8.48%). This reveals that, in relative terms, the revenue of Extremadura's social economy is higher than the national average.

In comparative terms, the percentage of employees within the social economy sector relative to Spain's total workforce exceeds that of Extremadura, standing at 6.75%. Nevertheless, the net revenue generated by the social economy sector, in relation to the overall economic volume, lags Extremadura's figures, registering at 8.48%. This discerning analysis underscores that, in relative metrics, Extremadura's social economy exhibits a superior financial performance, surpassing the national average in terms of revenue generation.

The two main groups that make up the Social Economy, entities from the market economy and non-market economy, have equal representation (50%) in direct employment in our community. In Spain, however, it is higher for non-market entities (58.9%) than for market entities (41.1%). Regarding the share in turnover, in Extremadura, market producers are responsible for almost 90% of the revenue, whereas in Spain, they account for only 77%. Non-market entities are responsible for the remaining percentage in both territories.

Within the realm of market entities in Extremadura, cooperatives emerge as the most substantial contributors to the direct employment volume, constituting a noteworthy 60.2%. Other entities within this group make up 25.3%, with supported employment centers representing 14.5% of the total. A comparable pattern is observed in Spain, where cooperatives account for 68.4% of direct employment, supported employment centers contribute 20.4%, and the remaining groups represent 11% of the workforce.

Concerning turnover, Extremadura's economic landscape is predominantly influenced by cooperatives, commanding a significant 90% of the total revenue. Worker-owned companies contribute 7%, and supported employment centers represent 6% of the turnover. In Spain, cooperatives dominate with 82% of the revenue, followed by worker-owned companies at 7.7% and supported employment centers at 6.8%. The residual market entities exhibit marginal representation in both regional contexts, underscoring the concentrated impact of cooperatives and supported employment centers in shaping the market dynamics.

In the realm of non-market entities, social action non-profit organizations exert substantial influence in both territorial areas, overshadowing the contributions of foundations and other entities. Regarding direct employment, social action non-profit organizations assume a prominent role, representing 83.3% in Extremadura and 66.4% in Spain. In Extremadura, foundations account for a mere 16.7% of employment, whereas in Spain, their share doubles, amounting to 33.6% of the workforce.

Regarding turnover, while specific data for foundations in Extremadura is unavailable, social action non-profit organizations exclusively contribute to the turnover, constituting almost 11% of the total turnover within the social economy. In Spain, non-market entities collectively generate 23% of the total turnover, with a significant portion, 68%, attributed to social action non-profit organizations. Foundations, on the other hand, contribute a relatively modest 32% to the overall turnover, underscoring the dominance of social action non-profit organizations in shaping the financial landscape of the non-market sector.

The preceding data provides a comprehensive insight into the prevailing significance of the social economy within our region. In broader terms, as delineated in the aforementioned White Paper, the social economy holds substantial importance in our community. Despite constituting a modest 2.82% of the total social economy entities in

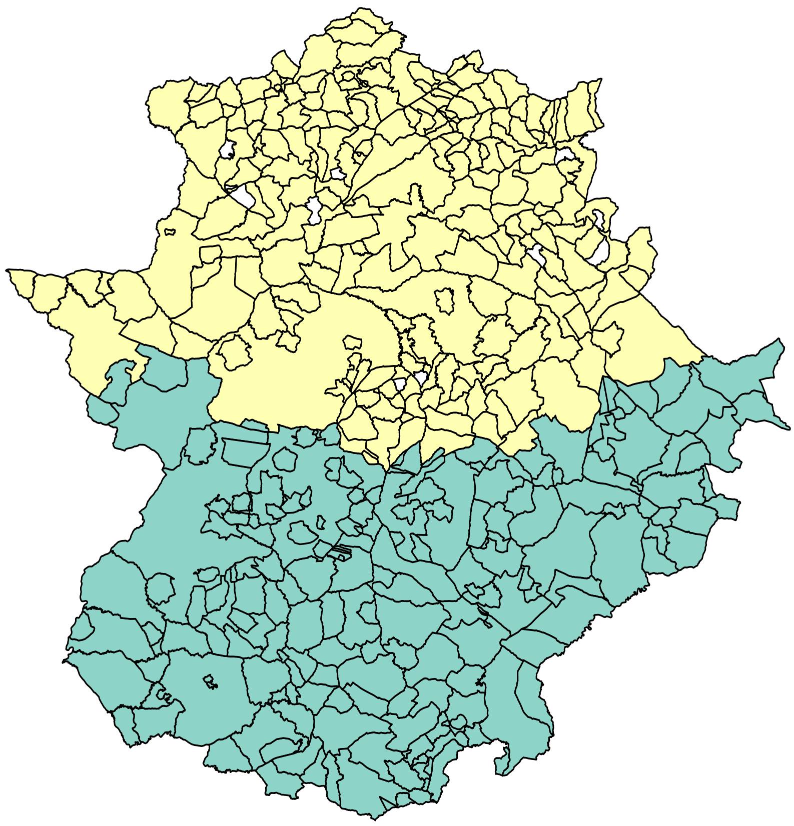
Spain, this percentage surpasses the representation of all Extremadura companies relative to the national total (1.98%). Furthermore, the relative turnover of these entities (2.38%) exceeds Extremadura's contribution to the overall Spanish GDP (1.65%), underscoring the relatively elevated economic impact of the social economy sector in our region.

These data accentuate the growing proliferation of the social economy in our region. Its distinctive attributes, characterized by democratic participation among its members and a steadfast focus on their well-being and familial welfare, facilitate the cultivation of a society marked by enhanced equity and efficiency. This approach not only fortifies job stability but also acts as a catalyst for population retention within the region (Vázquez et al., 2023).

4.3.2 Territorial characteristics (Control variables)

The analysis covers the period from 2015 to 2019 and includes data from 374 municipalities. Figure 4.9 shows the municipalities of Extremadura, highlighting their respective provinces: Cáceres in yellow and Badajoz in green.

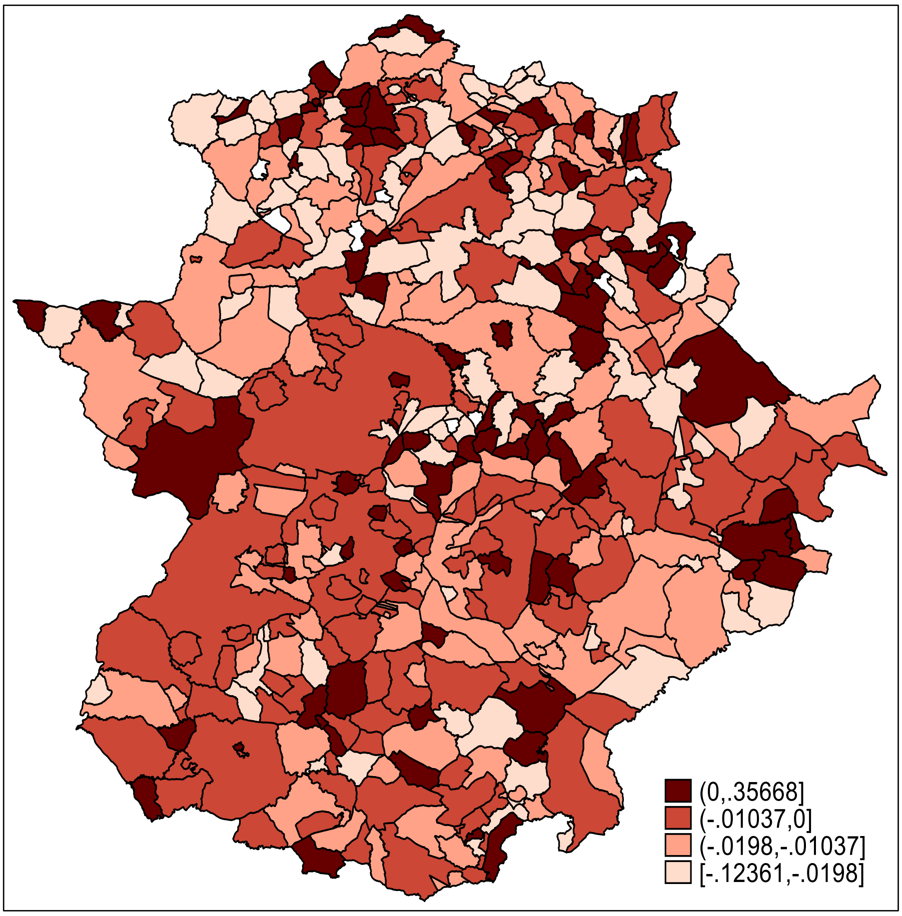
Figure 4.7 Municipalities in Extremadura



Source: Own elaboration

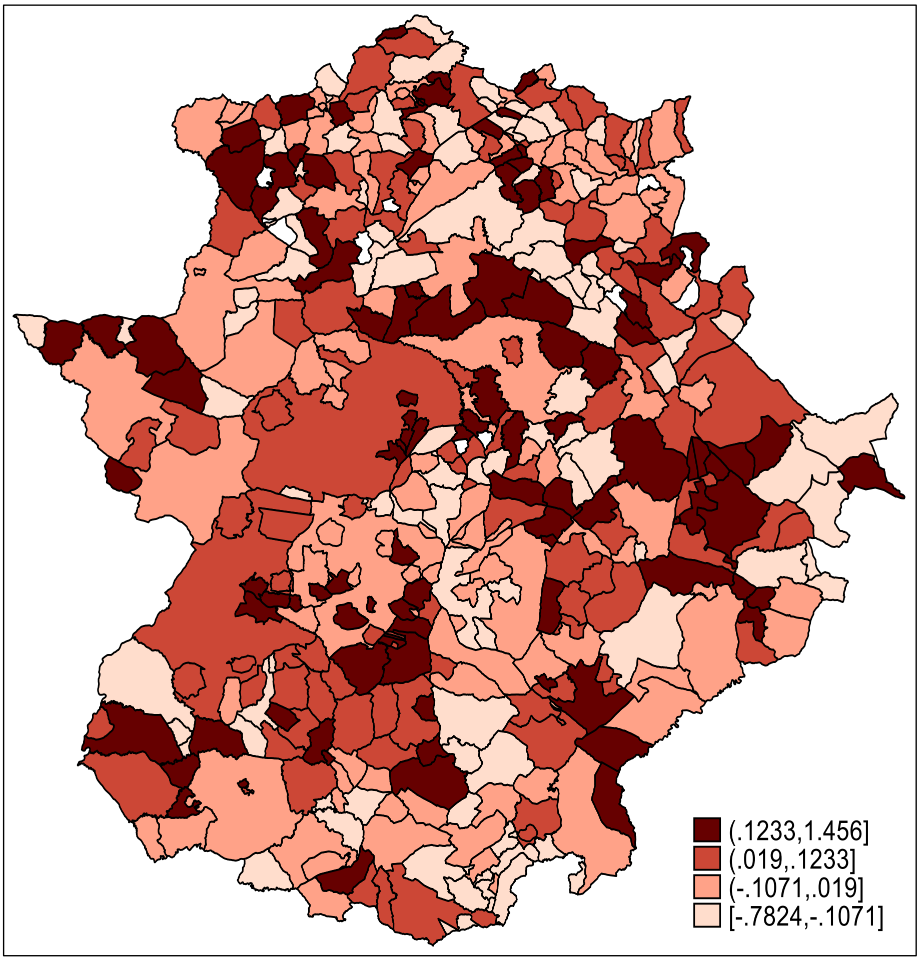
The main variables in this study are related to population and employment, specifically focusing on the growth of the working-age population (ages 16 to 65) and employment growth as endogenous variables. Figure 4.4 illustrates the growth of the working-age population, while Figure 4.5 depicts employment growth, both at the municipality level for the year 2019.

Figure 4.8 Working age population growth, 2019.



Source: Own elaboration

Figure 4.9 Employment growth, 2019.



Source: Own elaboration

In addition to endogenous variables (population and employment growth), our model incorporates additional territorial attributes that influence population and employment dynamics at the municipal level. As highlighted in the existing literature, these factors include aspects of accessibility, population demographics and socioeconomic conditions.

In relation to population characteristics, we find that populations under the age of 16 and those over the age of 65 significantly influence population attraction, as outlined in the literature. For the younger demographic, a positive attraction is anticipated, while for populations exceeding 65 years, a negative attraction is expected. Through a comprehensive literature review, the presence of foreign residents is regarded as an indicator of territorial strength, carrying a positive connotation. Accessibility is measured by factors such as proximity to major urban and logistical centers and the availability of banking services. Economic conditions play a critical role in attracting population, as evidenced by indicators such as the unemployment rate and per capita income. Moreover, within the context of economic considerations and as a reflection of a municipality's resilience, the inclusion of social economy elements, such as cooperatives, has been incorporated into the model.

The variables to be used in this work, along with their definitions and sources, are shown in Table 4.1. Meanwhile in table 4.2 are described the main statistics.

Table 4.1 Description of variables

Variable	Definition	Description	Source
shpop16	Population with less than 16 years old (in shares)	Total population less than 16/ total population	INE
shpob65	Population with more than 65 years old (in shares)	Total population more than 65/ total population	INE
shextr	Foreign population (in shares)	Total foreign population /Total population	INE
densp	Population density	Total population/km2	INE
of_banc	Total banking offices	Nummer of banking offices	Spanish Central Banck
Unemployment	Unemployment rate (employment/pop 15-65)	(Total of employment/pop between 15-65 years)	INE
km_Badajoz	Distance to Badajoz	Distance in Km from each municipality to main city (Badajoz)	Calculate with geonear (Stata)
Num coop	Number of Social Economy Entities		SABI
diver_shan	Sectoral diversity.	Shannon-Wiener Index[58]	INE
densemp	Employment density	Total employment/km2	INE
lrenta	Income (in logs)	Income per capita	INE

Source: Own elaboration

[58] diver_shan=-(shag*ln(shag)+shind*ln(shind)+shconst*ln(shconst)+shserv*ln(shserv))

Table 4.2 Main Statistics

Variable	Definition	Mean	Std. Dev.	min	max	Equation
shpop16	Population with less than 16 years old (in shares)	0.11	0.036	0.007	0.199	Population
shpob65	Population with more than 65 years old (in shares)	0.28	0.081	0.098	0.595	Population
shextr	Foreign population (in shares)	0.02	0.026	0.000	0.289	Population
densp	Population density	28.42	55.828	0.988	806.369	Population /employment
of_banc	Total banking offices	2.13	6.510	0.000	129.000	Population
Unemployment	Unemployment rate	0.16	0.043	0.054	0.347	Population
km_Badajoz	Distance to Badajoz	109.68	45.868	0.000	194.238	Population/ employment
Num coop	Number of Social Economy Entities	2.27	7.950	0.000	112.000	Population/ employment
diver_shan	Sectoral diversity	0.89	0.221	0.103	1.366	Employment
densemp	Employment density	18.15	40.167	0.369	515.287	employment
lrenta	Income (in logs)	8540.8	1178.59	5685.00	15929.00	employment

Source: Own elaboration

4.3.3 Proximity relations

Spatial spillovers and interterritorial connections have been calculated defining a threshold distance between municipalities. Considering these values and literature[59], we have defined surrounding areas considering a distance equal or less than 35 km. The statistics to mention distance are following:

[59] Feser et al. (2006) considers 30 km. de Graaff and Hoogstra 45 minutes.

Table 4.3 Neighbors statistics considering municipalities in a radius of 35 km.

Neighbors	Number
Minimum	5
Mean	34
Maximun	66

Source: Own elaboration

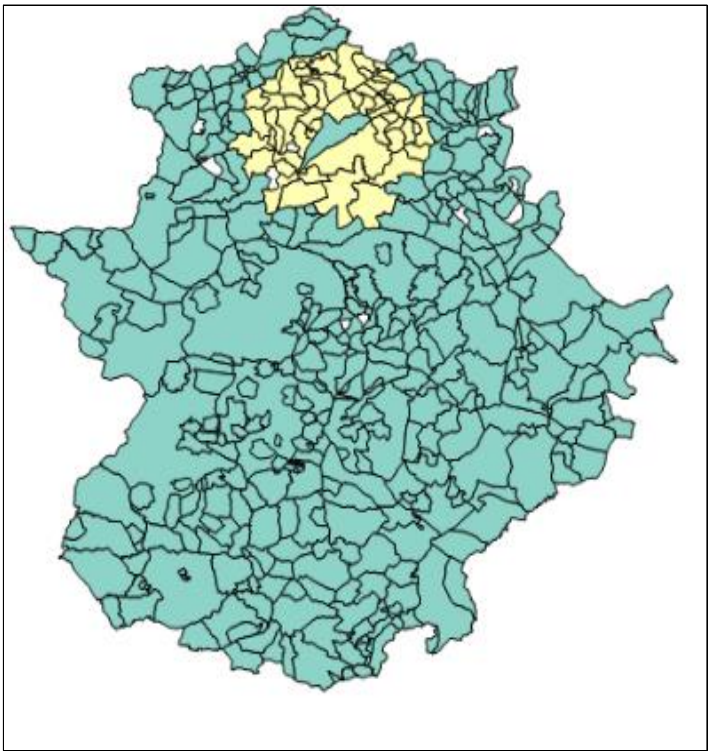
Therefore, according to Table 4.3, the minimum number of neighbouring municipalities for a given municipality in Extremadura is 5, the maximum is 66, and the average number of neighbors is 34.

As an example, in figure 4.10 and 4.11 is show the municipalities that are less than 35 km from Plasencia[60] and Guareña[61].

[60] Abadía, Aceituna, Ahigal, Aldeanueva del Camino, Aldehuela de Jerte, Arroyomolinos de la Vera, Barrado, Cabezabellosa, Cabrero, Cañaveral, Carcaboso, Casar de Palomero, Casas del Castañar, Casas del Monte, Casas de Millán, Cerezo, Coria, Galisteo, Garganta la Olla, Gargantilla, Gargüera, Granja, La, Guijo de Coria, Guijo de Galisteo, Guijo de Granadilla, Holguera, Jaraíz de la Vera, Jarilla, Majadas, Marchagaz, Mirabel, Mohedas de Granadilla, Montehermoso, Morcillo, Navaconcejo, Oliva de Plasencia, Palomero, Pasaron de la Vera, Pesga, La, Piornal, Pozuelo de Zarzón, Rebollar, Riolobos, Santa Cruz de Paniagua, Santibáñez el Bajo, Segura de Toro, Serradilla, Tejeda de Tiétar, Toril, Torno, El, Torrejoncillo, Torrejón el Rubio, Torremenga, Valdastillas, Valdeobispo, Villa del Campo, Villanueva de la Sierra, Villar de Plasencia, Zarza de Granadilla.

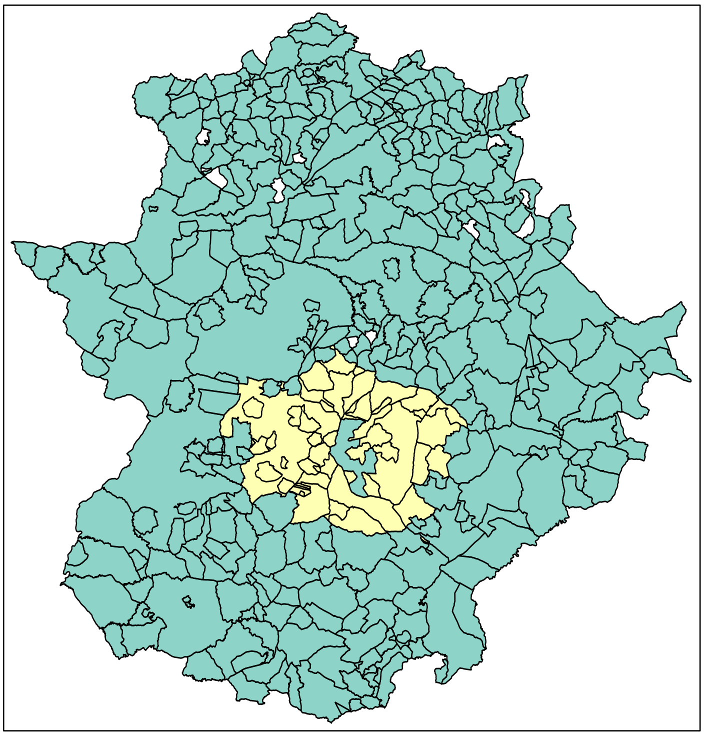
[61] Cristina, Alange, EL Carrascalejo, Don Benito, La Haba, Hornachos, Manchita, Mirandilla, Palomas, Puebla de la Reina, Puebla del Prior, Santa Amalia, Trujillanos, Valderorres, Valle de la Serena, Villagonzalo, Villar de la Rena, La Zarza, Arroyomolinos, Valdemorales, Majadas, San Pedro de Mérida, Aljucén, Don Álvaro, Torremejía, Mérida, Oliva de Mérida, Valverde de Mérida, Alcuéscar, Almoharín, Montánchez, Zarza de Montánchez.

Figure 4.10 Neighbourhood map, Plasencia (35km)



Source: Own elaboration

Figure 4.11 Neighbourhood map, Guareña (35km)



Source: Own elaboration

The Weight matrix (W) is specified in the following way:

$$w_{ij} = \{1\ if\ distance\ from\ i\ to\ j\ is\ less\ or\ equal\ to\ 35\ km$$
$$0\ if\ distance\ from\ i\ to\ j\ is\ more\ to\ 35\ km\ of\ i = j \qquad (1)$$

The matrix W is row-standardized as $w_{ij} = \frac{w_{ij}}{\sum_{i=1}^{N} w_{ij}}$,which ensures that the sum of each row of W is equal to one.

Local employment area defined by matrix, is composed by rural, semiurban and urban municipalities, according to the nature of each municipalities the spillovers generate by connections by pairs (commuting) should be heterogeneous. It is not the same spatial effect between two rural municipalities than between a rural and urban or semiurban municipality. The relationship is not homogeneous. Boarnet and other authors, do not consider this relationship. Our model, based on the simultaneous equation of Carlino and Mills (1987) is extended, including the heterogeneity in spatial relations (Feser and Isserman, 2006).

4.4 Econometric model

Our model is based on the framework introduced by Carlino and Mills (1987), in which population and employment growth are treated as endogenous variables. In addition, our model is extended according to the model of Boarnet (1994), who introduced spillover or backwash effects relating to employment and population dynamics between neighbouring municipalities.

In equilibrium, the relationships between population and employment are realized in the labour market area, so that commuting between municipalities indicates that people choose to locate their home in a given municipality, while their job opportunities are in the own municipality but also in surrounding area and, likewise, equilibrium municipal employment depends on the population living in the own municipality and in neighbourhood. Therefore, population and employment are determined as follows:

$$P_{it}^{*} = f[M_{it}, E_{it}^{*}, \bar{E}\,_{it}^{*}] \qquad (2)$$

$$E_{it}^{*} = f[N_{it}, P_{it}^{*}, \bar{P}\,_{it}^{*}] \qquad (3)$$

Being, E_{it}^{*} equilibrium employment in own municipality and $\bar{E}\,_{it}^{*}$ equilibrium employment in municipalities that are neighbors of the municipality i. P_{it}^{*} represent the equilibrium population in municipality i and $\bar{P}^*_{it}$ the equilibrium population in municipalities that are neighbors of the municipality i.

According to definition of proximity relation presented in previous section, $\bar{E}^*_{it}$ and $\bar{P}^*_{it}$ is defined in the following way:

$$\bar{E}^*_{it} = W\ x\ E^*_{it} \quad (4)$$

$$\bar{P}^*_{it} = W\ x\ P^*_{it} \quad (5)$$

Being W, the weight matrix defined as in equation (1)

Analogous to the work of Carlino and Mills (1987), our study, adopts the lag adjustment model for alterations in population and employment, as originally proposed by Mills and Price (1984):

$$\Delta P_{it} = P_{it} - P_{it-1} = \lambda_p(P^*_{it} - P_{it-1}) \quad (6)$$

$$\Delta E_{it} = E_t - E_{t-1} = \lambda_E(E^*_{it} - E_{it-1}) \quad (7)$$

Being λ_py λ_E the parameters associated with the partial adjustment to a log-run equilibrium.

The citation author considers the same lag adjustment for the labour market area: $\bar{P}$, $\bar{E}$.

$$\Delta\bar{P}_{it} = \bar{P}_{it} - \bar{P}_{it-1} = \lambda_{\bar{p}}[\bar{P}^*_{it} - \bar{P}_{it-1}] \quad (8)$$

$$\Delta\bar{E}_{it} = \bar{E}_{it} - \bar{E}_{it-1} = \lambda_{\bar{E}}[\bar{E}^*_{it} - \bar{E}_{it-1}] \quad (9)$$

Assuming a linear combination in (2) and (3):

$$P^*_{it} = \beta_0 + \beta_1 M_{it} + \beta_2 E^*_{it} + \beta_3 \bar{E}^*_i + \varepsilon_{it} \quad (10)$$

$$E^*_{it} = \tau_0 + \tau_1 N_{it} + \tau_2 P^*_{it} + \tau_3 \bar{P}^*_i + \xi_{it} \quad (11)$$

and changes in population and employment (equation 6, 7, 8 and 9),

$$P_{it} - P_{it-1} = \lambda_p P^*_{it} - \lambda_p P_{it-1}; \qquad P^*_{it} = \frac{1}{\lambda_p}\Delta P_{it} + P_{it-1} \quad (12)$$

$$E_{it} - E_{it-1} = \lambda_E E^*_{it} - \lambda_E E_{it-1}; \qquad E^*_{it} = \frac{1}{\lambda_E}\Delta E_{it} + E_{it-1} \quad (13)$$

$$\bar{P}_{it} - \bar{P}_{it-1} = \lambda_{\bar{p}} \bar{P}^*_{it} - \lambda_{\bar{p}} \bar{P}_{it-1}; \qquad \bar{P}^*_{it} = \frac{1}{\lambda_{\bar{p}}}\Delta\bar{P}_{it} + \bar{P}_{it-1} \quad (14)$$

$$\bar{E}_{it} - \bar{E}_{it-1} = \lambda_{\bar{E}} \bar{E}^*_{it} - \lambda_{\bar{E}} \bar{E}_{it-1}\ ; \qquad \bar{E}^*_{it} = \frac{1}{\lambda_{\bar{E}}}\Delta\bar{E}_{it} + \bar{E}_{it-1} \quad (15)$$

Substituting in equations (6) and (7):

$$\Delta P_{it} = \lambda_p[\beta_0 + \beta_1 M_{it} + \beta_2 E_{it}^* + \beta_3 \bar{E}_i^* + \varepsilon_{it}] - \lambda_p P_{it-1} = \lambda_p \Big[\beta_0 + \beta_1 M_{it} + \beta_2 \left(\frac{1}{\lambda_E}\Delta E_{it} + E_{it-1}\right) + \beta_3 \left(\frac{1}{\lambda_{\bar{E}}}\Delta \bar{E}_{it} + \bar{E}_{it-1}\right) + \varepsilon_{it}\Big] - \lambda_p P_{it-1} = \lambda_p\beta_0 + \lambda_p\beta_1 M_{it} + \lambda_p\beta_2\frac{1}{\lambda_E}\Delta E_{it} + \lambda_p\beta_2 E_{it-1} + \lambda_p\beta_3\frac{1}{\lambda_{\bar{E}}}\Delta\bar{E}_{it} + \lambda_p\beta_3\bar{E}_{it-1} + \lambda_p\varepsilon_{it} - \lambda_p P_{it-1} \quad (16)$$

$$\Delta E_{it} = \lambda_E[\tau_0 + \tau_1 N_{it} + \tau_2 P_{it}^* + \tau_3 \bar{P}_i^* + \xi_{it}] - \lambda_E E_{it-1} = \lambda_E \Big[\tau_0 + \tau_1 N_{it} + \tau_2\left(\frac{1}{\lambda_p}\Delta P_{it} + P_{it-1}\right) + \tau_3\left(\frac{1}{\lambda_{\bar{p}}}\Delta\bar{P}_{it} + \bar{P}_{it-1}\right) + \xi_{it}\Big] - \lambda_E E_{it-1} = \lambda_E\tau_0 + \lambda_E\tau_1 N_{it} + \lambda_E\tau_2\frac{1}{\lambda_p}\Delta P_{it} + \lambda_E\tau_2 P_{it-1} + \lambda_E\tau_3\frac{1}{\lambda_{\bar{p}}}\Delta\bar{P}_{it} + \lambda_E\tau_3\bar{P}_{it-1} + \lambda_E\xi_{it} - \lambda_E E_{it-1} \quad (17)$$

And replacing the parameters to simplify the expression:

$$\gamma_0 = \lambda_p\beta_0;\ \ \gamma_1 = \lambda_p\beta_1\ ;\gamma_2 = \lambda_p\beta_2;\ \gamma_3 = \lambda_p\beta_2\frac{1}{\lambda_E};\ \gamma_4 = \lambda_p\beta_3;$$

$$\gamma_5 = \lambda_p\beta_3\frac{1}{\lambda_{\bar{E}}};\ \ \epsilon_{it} = \lambda_p\varepsilon_{it} \quad (18)$$

$$\alpha_0 = \lambda_E\tau_0\ ;\alpha_1 = \lambda_E\tau_1\ ;\ \alpha_2 = \lambda_E\tau_2\ ;\ \alpha_3 = \lambda_E\tau_2\frac{1}{\lambda_p};\ \alpha_4 = \lambda_E\tau_3\ ;$$

$$\alpha_5 = \lambda_E\tau_3\frac{1}{\lambda_{\bar{p}}}\ ;\eta_{it} = \lambda_E\xi_{it} \quad (19)$$

The system of equations model is as follows:

$$\Delta P_i = \gamma_0 + \gamma_1 M_{i,t} + \gamma_2 E_{it-1} + \gamma_3\Delta E_{it} + \gamma_4\bar{E}_{i,t-l} + \gamma_5\Delta\bar{E}_{i,t} - \lambda_p P_{i,t-l} + \epsilon_{it} \quad (20)$$

$$\Delta E_i = \alpha_0 + \alpha_1 N_{i,t} + \alpha_2 P_{it-1} + \alpha_3\Delta P_{it} + \alpha_4\bar{P}_{i,t-l} + \alpha_5\Delta\bar{P}_{i,t} - \lambda_E E_{i,t-l} + \eta_{it} \quad (21)$$

In relation to equation (20), ΔP_i denote the absolute change in population t and t-l. The term $\bar{E}_{i,t-l}$ and $\Delta\bar{E}_{i,t}$ signify the total and absolute employment change in the areas within a radius of “d” km from municipality i. Meanwhile, $P_{i,t-l}$ represents the population at time t–l and $C_{i,t-l}$ denotes the characteristics associated with the geographical area (i) that determine population growth.

Equation (21) parallels equation (20) in its formulation. However, in this instance, the endogenous variable on the left-hand side refers to the absolute change in employment. On the right-hand, we observe the representation of both total and absolute change in population within the environs of municipality i, denote as $\bar{P}_{i,t-l}$ and $\Delta\bar{P}_{i,t}$, respectively. Analogously to equation (7), $D_{i,t-l}$ indicates the characteristics associated with area (i) that are related on employment change. Notably, both $\Delta\bar{E}_{i,t}$ and $\Delta\bar{P}_{i,t}$, are regarded as endogenous cross-spatial lagged variables located on the right-hand side (RHS), (Rey and Boarnet, 2004).

The main objective of this study is to empirically examine the interdependencies among neighbouring municipalities with distinct degrees of urbanization. In accordance with our model, equilibrium relationships depend on the population and employment levels in the surrounding municipalities classified by their urbanization level: urban, intermediate, and rural. Furthermore, the equilibrium of the municipality is determined by its own demographic and employment characteristics:

$$P^*_{i,t} = f(C_{i,t}, E^*_{i,t}, U\bar{E}^*_{i,t}, S\bar{E}^*_{i,t}, R\bar{E}^*_{i,t}) \qquad (22)$$

$$E^*_{i,t} = f(D_{i,t}, P^*_{i,t}, U\bar{P}^*_{i,t}, S\bar{P}^*_{i,t}, R\bar{P}^*_{i,t}) \qquad (23)$$

Being $E_{i,t}$* and $P_{i,t}$* employment and equilibrium population in the municipality i $U\bar{E}^*_{i,t}, S\bar{E}^*_{i,t}, R\bar{E}^*_{i,t}$ and $U\bar{P}^*_{i,t}, S\bar{P}^*_{i,t}, R\bar{P}^*_{i,t}$ represent the employment and equilibrium population in the municipalities located at a certain distance from municipality i.

Our model follows the same structure as in Feser and Isserman (2006), but unlike the aforementioned authors, we are interested in studying the equilibrium relationship shown in expressions (22) and (23)[62]. Although the model allows us to study all the inter-territorial interconnections, referred to both equations (22, 23), our main interest is focused on analysing the population dynamics generated by economic activity and as a function of the level of urbanization of the municipality. Therefore, our main hypothesis is to check whether the spillovers generated by inter-territorial relations between municipalities are independent of the level of urbanization, or whether the economic development of the municipalities is affecting these spatial effects. This knowledge will justify targeting territorial policy to the employment centers with the greatest spillover effects on the territory.

Considering a linear combination of equations (22) and (23):

$$P^*_{i,t} = \beta_0 + \beta_1 M_{i,t} + \beta_2 E^*_{i,t} + \beta_3 U\bar{E}^*_{i,t} + \beta_4 S\bar{E}^*_{i,t} + \beta_5 R\bar{E}^*_{i,t} + \varepsilon_{i,t} \qquad (24)$$

[62] In their work, Feser and Isserman (2006) establish a comprehensive model designed to investigate the interdependencies between population growth and change in adjacent regions, as well as the analogous relationships concerning employment growth and change in neighboring areas:

$$P^*_{i,t} = f(C_{i,t}, E^*_{i,t}, U\bar{P}^*_{i,t}, S\bar{P}^*_{i,t}, R\bar{P}^*_{i,t})$$

$$E^*_{i,t} = f(D_{i,t}, P^*_{i,t}\ U\bar{E}^*_{i,t}, S\bar{E}^*_{i,t}, R\bar{E}^*_{i,t})$$

$$E^*_{i,t} = \tau_0 + \tau_1 N_{i,t} + \tau_2 \, P^*_{i,t} + \tau_3 \, U\bar{P}^*_{i,t} + \tau_4 S\bar{P}^*_{i,t} + \tau_5 \, R\bar{P}^*_{i,t} + \zeta_{i,t} \quad (25)$$

The lag adjustment model, as established by Carlino and Mills (1987), presented in equations (12)-(15) and according to each level of urbanization (26)-(31) are as follows:

$$U\bar{P}_{it} - U\bar{P}_{it-1} = \lambda_{u\bar{p}} U\bar{P}^*_{i,t} - \lambda_{u\bar{p}} U\bar{P}_{i,t-1}; \qquad U\bar{P}^*_{it} = \frac{1}{\lambda_{u\bar{p}}} \Delta \mathrm{U}\bar{P}_{it} + U\bar{P}_{i,t-1} \quad (26)$$

$$S\bar{P}_{it} - S\bar{P}_{it-1} = \lambda_{s\bar{p}} S\bar{P}^*_{i,t} - \lambda_{s\bar{p}} S\bar{P}_{i,t-1}; \qquad S\bar{P}^*_{it} = \frac{1}{\lambda_{s\bar{p}}} \Delta \mathrm{S}\bar{P}_{it} + S\bar{P}_{i,t-1} \quad (27)$$

$$R\bar{P}_{it} - R\bar{P}_{it-1} = \lambda_{r\bar{p}} R\bar{P}^*_{i,t} - \lambda_{r\bar{p}} R\bar{P}_{i,t-1}; \qquad R\bar{P}^*_{it} = \frac{1}{\lambda_{r\bar{p}}} \Delta \mathrm{R}\bar{P}_{it} + R\bar{P}_{i,t-1} \quad (28)$$

$$U\bar{E}_{it} - U\bar{E}_{it-1} = \lambda_{u\bar{E}} U\bar{E}^*_{i,t} - \lambda_{u\bar{E}} U\bar{E}_{i,t-1}\,; \qquad U\bar{E}^*_{i,t} = \frac{1}{\lambda_{u\bar{E}}} \Delta U\bar{E}^*_{i,t} + U\bar{E}_{it-1} \quad (29)$$

$$S\bar{E}_{it} - S\bar{E}_{it-1} = \lambda_{s\bar{E}} S\bar{E}^*_{i,t} - \lambda_{s\bar{E}} S\bar{E}_{i,t-1}\,; \qquad S\bar{E}^*_{i,t} = \frac{1}{\lambda_{s\bar{E}}} \Delta S\bar{E}^*_{i,t} + S\bar{E}_{it-1} \quad (30)$$

$$R\bar{E}_{it} - R\bar{E}_{it-1} = \lambda_{r\bar{E}} R\bar{E}^*_{i,t} - \lambda_{r\bar{E}} R\bar{E}_{i,t-1}\,; \qquad R\bar{E}^*_{i,t} = \frac{1}{\lambda_{r\bar{E}}} \Delta R\bar{E}^*_{i,t} + R\bar{E}_{it-1} \quad (31)$$

Therefore, substituting the lineal combination (24) and (25) into the lag adjustment model of population and employment (equations (8) and (9)) and the corresponding lag adjustment of equilibrium expression (26)-(31), the simultaneous equations, can be expressed as follows:

$$\Delta P_{it} = \lambda_p (P^*_{it} - P_{it-1}) = \lambda_p \big[\beta_0 + \beta_1 M_{i,t} + \beta_2 \, E^*_{i,t} + \beta_3 \, U\bar{E}^*_{i,t} + \beta_4 S\bar{E}^*_{i,t} + \beta_5 \, R\bar{E}^*_{i,t} + \varepsilon_{i,t} \big] - \lambda_p P_{it-1} = \lambda_p \Big[\beta_0 + \beta_1 M_{it} + \beta_2 \left(\frac{1}{\lambda_E} \Delta E_{it} + E_{it-1}\right) + \beta_3 \left(\frac{1}{\lambda_{\overline{UE}}} \Delta \mathrm{U}\bar{E}_{it} + U\bar{E}_{it-1}\right) + \beta_4 \left(\frac{1}{\lambda_{\overline{SE}}} \Delta \mathrm{S}\bar{E}_{it} + S\bar{E}_{it-1}\right) + \beta_5 \left(\frac{1}{\lambda_{\overline{RE}}} \Delta \mathrm{R}\bar{E}_{it} + R\bar{E}_{it-1}\right) + \varepsilon_{it} \Big] - \lambda_p P_{it-1} = \lambda_p \beta_0 + \lambda_p \beta_1 M_{it} + \lambda_p \beta_2 \frac{1}{\lambda_E} \Delta E_{it} + \lambda_p \beta_2 E_{it-1} + \lambda_p \beta_3 \frac{1}{\lambda_{\overline{UE}}} \Delta \overline{UE}_{it} + \lambda_p \beta_3 \overline{UE}_{it-1} + \lambda_p \beta_4 \frac{1}{\lambda_{\overline{SE}}} \Delta \overline{SE}_{it} + \lambda_p \beta_4 \overline{SE}_{it-1} + \lambda_p \beta_5 \frac{1}{\lambda_{\overline{RE}}} \Delta \overline{RE}_{it} + \lambda_p \beta_5 \overline{RE}_{it-1} + \lambda_p \varepsilon_{it} - \lambda_p P_{it-1} \quad (32)$$

$$\Delta E_{it} = \lambda_p (E^*_{it} - E_{it-1}) = \lambda_p \lambda_E [\tau_0 + \tau_1 N_{it} + \tau_2 P^*_{it} + \tau_3 U\bar{P}^*_i + \tau_4 S\bar{P}^*_i + \tau_5 R\bar{P}^*_i + \xi_{it}] - \lambda_E E_{it-1} = \lambda_E \Big[\tau_0 + \tau_1 N_{it} + \tau_2 \left(\frac{1}{\lambda_p} \Delta P_{it} + P_{it-1}\right) + \tau_3 \left(\frac{1}{\lambda_{\overline{Up}}} \Delta \mathrm{U}\bar{P}_{it} + \overline{UP}_{it-1}\right) + \tau_4 \left(\frac{1}{\lambda_{\overline{Sp}}} \Delta \mathrm{S}\bar{P}_{it} + \overline{SP}_{it-1}\right) + \xi_{it}\Big] + \tau_5 \left(\frac{1}{\lambda_{\overline{Rp}}} \Delta \mathrm{R}\bar{P}_{it} + \overline{RP}_{it-1}\right) + \xi_{it} - \lambda_E E_{it-1} = \lambda_E \tau_0 + \lambda_E \tau_1 N_{it} +$$

$$\lambda_E\tau_2\frac{1}{\lambda_p}\Delta P_{it}+\lambda_E\tau_2 P_{it-1}+\lambda_E\tau_3\frac{1}{\lambda_{\overline{Up}}}\Delta \mathrm{U}\bar{P}_{it}+\lambda_E\tau_3\overline{UP}_{it-1}+\lambda_E\tau_4\frac{1}{\lambda_{\overline{Sp}}}\Delta \mathrm{S}\bar{P}_{it}+\lambda_E\tau_4\overline{SP}_{it-1}+$$
$$\lambda_E\tau_5\frac{1}{\lambda_{\overline{Rp}}}\Delta \mathrm{R}\bar{P}_{it}+\lambda_E\tau_5\overline{RP}_{it-1}+\lambda_E\xi_{it}-\lambda_E E_{it-1} \quad (33)$$

Simplifying and rearranging, using parameters of expressions: (34) and (35)

$$\gamma_0=\lambda_p\beta_0;\ \gamma_1=\lambda_p\beta_1\ ;\gamma_2=\lambda_p\beta_2\frac{1}{\lambda_E};\ \gamma_3=\lambda_p\beta_2;\ \gamma_4=\lambda_p\beta_3\frac{1}{\lambda_{\overline{UE}}};\ \gamma_5=\lambda_p\beta_3;\gamma_6=$$
$$\lambda_p\beta_4\frac{1}{\lambda_{\overline{SE}}};\ \gamma_7=\lambda_p\beta_4;\ \gamma_8=\lambda_p\beta_5\frac{1}{\lambda_{\overline{RE}}};\ \gamma_9=\lambda_p\beta_5\ ;\epsilon_{it}=\lambda_p\varepsilon_{it} \quad (34)$$

$$\alpha_0=\lambda_E\tau_0\ ;\alpha_1=\lambda_E\tau_1\ ;\ ;\alpha_2=\lambda_E\tau_2\frac{1}{\lambda_p};\ \ \alpha_3=\lambda_E\tau_2\ \ ;\alpha_4=\lambda_E\tau_3\frac{1}{\lambda U_{\bar{p}}}\ ;\alpha_5=\lambda_E\tau_3;$$
$$\alpha_6=\lambda_E\tau_4\frac{1}{\lambda_{\overline{Sp}}}\ ;\alpha_7=\lambda_E\tau_4;\ \alpha_8=\lambda_E\tau_5\frac{1}{\lambda_{R\bar{p}}}\ ;\alpha_9=\lambda_E\tau_5\ ;\eta_{it}=\lambda_E\xi_{it} \quad (35)$$

the equation system is as following:

$$\Delta P_{it}=\gamma_0+\gamma_1M_{it}+\gamma_2\Delta E_{it}+\gamma_3E_{it-1}+\gamma_4\Delta\overline{UE}_{it}+\gamma_5\overline{UE}_{it-1}+\gamma_6\Delta\overline{SE}_{it}+\gamma_7\overline{SE}_{it-1}+$$
$$\gamma_8\Delta\overline{RE}_{it}+\gamma_9\overline{RE}_{it-1}-\lambda_pP_{it-1}+\epsilon_{it} \quad (36)$$

$$\Delta E_{it}=\alpha_0+\alpha_1N_{it}+\alpha_2\Delta P_{it}+\alpha_3P_{it-1}+\alpha_4\Delta \mathrm{U}\bar{P}_{it}+\alpha_5\overline{UP}_{it-1}+\alpha_6\Delta \mathrm{S}\bar{P}_{it}+\alpha_7\overline{SP}_{it-1}+$$
$$\alpha_8\Delta \mathrm{R}\bar{P}_{it}+\alpha_9\overline{RP}_{it-1}-\lambda_EE_{it-1}+\eta_{it} \quad (37)$$

We incorporate two categorical dummy variables, namely “urban” and “semi-urban”, with “rural” as the reference category. These variables, denoted V_U and V_S, are introduced into the model to determine interaction terms and decompose spillover effects (Feser and Isserman, 2006).

$$V_U=1\ if\ municipality\ is\ urban;\ V_U=0\ otherwise$$
$$V_S=1\ if\ municipality\ is\ semi-urban;\ V_S=0\ otherwise$$

Consequently, this allows us to examine the interrelationships between municipalities categorized as rural, semi-urban and urban. The final formulation of the system of population-employment equations is succinctly represented in expressions (38) and (39).

$$\Delta P_{it}=\gamma_0+\gamma_1M_{it}+\gamma_2\Delta E_{it}+\gamma_3E_{it-1}+\gamma_4\Delta\overline{UE}_{it}+\gamma_5\overline{UE}_{it-1}+\gamma_6\Delta\overline{SE}_{it}+\gamma_7\overline{SE}_{it-1}+$$
$$\gamma_8\Delta\overline{RE}_{it}+\gamma_9\overline{RE}_{it-1}+V_U(\gamma_{10}\Delta\overline{UE}_{it}+\gamma_{11}\Delta\overline{SE}_{it}+\gamma_{12}\Delta\overline{RE}_{it})+V_S(\gamma_{13}\Delta\overline{UE}_{it}+\gamma_{14}\Delta\overline{SE}_{it}+$$
$$\gamma_{15}\Delta\overline{RE}_{it})-\lambda_pP_{it-1}+\epsilon_{it} \quad (38)$$

$$\Delta E_{it} = \alpha_0 + \alpha_1 N_{it} + \alpha_2 \Delta P_{it} + \alpha_3 P_{it-1} + \alpha_4 \Delta \mathrm{U}\bar{P}_{it} + \alpha_5 \overline{UP}_{it-1} + \alpha_6 \Delta \mathrm{S}\bar{P}_{it} + \alpha_7 \overline{SP}_{it-1} + \alpha_8 \Delta \mathrm{R}\bar{P}_{it} + \alpha_9 \overline{RP}_{it-1} + V_U(\alpha_{10} \Delta \mathrm{U}\bar{P}_{it} + \alpha_{11} \Delta \mathrm{S}\bar{P}_{it} + \alpha_{12} \Delta \mathrm{R}\bar{P}_{it}) + V_S(\alpha_{13} \Delta \mathrm{U}\bar{P}_{it} + \alpha_{14} \Delta \mathrm{S}\bar{P}_{it} + \alpha_{15} \Delta \mathrm{R}\bar{P}_{it}) - \lambda_E E_{it-1} + \eta_{it} \quad (39)$$

The inclusion of interaction terms, as delineated in equations (38) and (39), facilitates an empirical examination of the impact of employment growth on population dynamics, and vice versa, within surrounding urban, semi-urban, and rural municipalities. This analysis dissects the interplay of these factors at the municipal level, further disaggregating the effects within the urban, semi-urban, and rural categories.

Tables 4.4 and 4.5 provide a comprehensive summary of the inter-territorial linkages between municipalities characterized by different levels of urbanization, as elucidated by the interaction terms set out in equations (38) and (39). The sign of the spatial spillovers serves as an indicator of the direction and magnitude of the spillover effects, revealing the interaction between population and employment, and their corresponding forward and backward effects.

Table 4.4 Influence of neighbouring employment variation on local population change (rural municipalities are the base case).

	Population changes in municipalities		
Employment change of surroundings areas	**Urban**	**Semiurban**	**Rural**
Urban	$\gamma_4 + \gamma_{10}$	$\gamma_4 + \gamma_{13}$	γ_4
Semiurban	$\gamma_6 + \gamma_{11}$	$\gamma_6 + \gamma_{14}$	γ_6
rural	$\gamma_8 + \gamma_{12}$	$\gamma_8 + \gamma_{15}$	γ_8

Source: Own elaboration

Table 4.5 Influence of neighbouring population change on local employment change (rural municipalities are the base case)

	Employment changes in municipalities		
Population changes of surroundings areas	**Urban**	**Semiurban**	**Rural**
Urban	$\alpha_4 + \alpha_{10}$	$\alpha_4+\alpha_{13}$	α_4
Semiurban	$\alpha_6+ \alpha_{11}$	$\alpha_6+\alpha_{14}$	α_6
rural	$\alpha_8+ \alpha_{12}$	$\alpha_8 + \alpha_{15}$	α_8

Source: Own elaboration

For a more comprehensive explanation of Tables 4.4 and 4.5, the term $(\gamma_4 + \gamma_{13})$ (as presented in Table 4.4) signifies the spillover effects influencing the population dynamics of a semi-urban municipality. These effects result from alterations in employment levels within the urban municipalities situated in surrounding.

$(\alpha_8+ \alpha_{12})$ reflect the employment change in certain urban municipality that are consequence of changes in population in rural municipalities that are in surrounding.

The estimation of the model is performed using the three-stage least squares estimator of generalized spatial methods (GMM), as described in Kelejian and Prucha (1998) and Kelejian and Prucha (2004). The model is characterized by the simultaneity of the feedback and the cross regressive spatial lag variable, with the cross regressive spatial term having a similar consideration to the endogenous spatial lag variables (Rey and Boarnet, 2004). As widely used by scholars (Graaff, van Oort and Florax, 2012; Henry, Schmitt, Kristensen, Barkley and Bao, 1999; Feser and Isserman, 2006; Henry, Schmitt and Piguet, 2001; Hoogstra, 2012), the instruments used are the exogenous variables and their corresponding spatial lags (first and second order). The spatial heterogeneity among municipalities was controlled by introducing the municipalities fixed effects.

To a better explanation of variables described in equations (38) and (39) in Table 4.6 are detailed the endogenous variables and the interaction effects.

Table 4.6 Population/Employment variables.

	Variables	Definition	ΔP	ΔE
Dependent Variables	$\Delta P_{i,t}$	Change in working age population in municipality i	X	
	$\Delta E_{i,t}$	Change in employment in municipality i		X
	$E_{i,t-1}$	Employment in t-1 in municipality i	X	X
	$P_{i,t-1}$	Working age population in t-1 in municipality i	X	X
Spatial lag variables	$\Delta U\bar{E}_{it-1}$	change in urban employment in municipalities in radius *35 km*	X	
	$\Delta S\bar{E}_{it-1}$	change in semi-urban employment in municipalities in radius *35 km*	X	
	$\Delta R\bar{E}_{it-1}$	change in rural employment in municipalities in radius *35 km*	X	
	$\Delta U\bar{P}_{it-1}$	change in urban population in municipalities in radius *35 km*		X
	$\Delta S\bar{P}_{it-1}$	change in semi-urban population, in municipalities in radius *35 km*		X
	$\Delta R\bar{P}_{it-1}$	change in rural population, in municipalities in radius *35 km*		X
	$U\bar{E}_{it-1}$	Spatial lag on employment (working age) in urban municipalities	X	
	$S\bar{E}_{it-1}$	Spatial lag on employment (working age) in semi-urban municipalities	X	
	$R\bar{E}_{it-1}$	Spatial lag on employment (working age) in rural municipalities	X	
	$U\bar{P}_{it-1}$	Spatial lag on population (working age) in urban municipalities		X
	$S\bar{P}_{it-1}$	Spatial lag on population (working age) in semi-urban municipalities		X
	$R\bar{P}_{it-1}$	Spatial lag on population in t-1 (working age) in rural municipalities		X
Dummy variable	V_U	urban=1, otherwise=0	X	X
	V_S	semi-urban=1, otherwise=0	X	X
Interaction terms to manage the influence of employment variations in neighbouring municipalities on population of URBAN AREAS $V_U = 1$ $V_S = 0$	$\overline{\Delta UE}_{it-1} + V_U\overline{\Delta UE}_{it-1}$	Differential effect from urban-to-urban municipalities	X	
	$\overline{\Delta SE}_{it-1} + V_U\overline{\Delta SE}_{it-1}$	Differential effect from semi-urban to urban municipalities	X	
	$\overline{\Delta RE}_{it-1} + V_U\overline{\Delta RE}_{it-1}$	Differential effect from rural to urban municipalities	X	
Interaction terms to manage the influence of employment variations in neighbouring municipalities on population of	$\overline{\Delta UE}_{it-1} + V_S\overline{\Delta UE}_{it-1}$	Differential effect from urban to semi-urban municipalities	X	
	$\overline{\Delta SE}_{it-1} + V_S\overline{\Delta SE}_{it-1}$	Differential effect from semi-urban-to-semi-urban municipalities	X	

SEMI-URBAN AREAS $V_U = 0$ $V_S = 1$	$\overline{\Delta RE}_{it-1} + V_S\overline{\Delta RE}_{it-1}$	Differential effect from rural to semi-urban municipalities	X	
Interaction terms to manage the influence of employment variations in neighbouring municipalities on population of RURAL AREAS (base case) $V_U = 0$ $V_S = 0$	$\overline{\Delta UE}_{it-1}$	Differential effect from urban to rural municipalities	X	
	$\overline{\Delta SE}_{it-1_R}$	Differential effect from semi-urban to rural municipalities	X	
	$\overline{\Delta RE}_{it-1}$	Differential effect from rural-to-rural municipalities	X	
Interaction terms to manage the influence of population variations in neighbouring municipalities on employment of URBAN AREAS $V_U = 1$ $V_S = 0$	$\overline{\Delta UP}_{it-1} + V_U\overline{\Delta UP}_{it-1}$	Differential effect from urban-to-urban municipalities		X
	$\overline{\Delta SP}_{it-1} + V_U\overline{\Delta SP}_{it-1}$	Differential effect from semi-urban to urban municipalities		X
	$\overline{\Delta RP}_{it-1} + V_U\overline{\Delta RP}_{it-1}$	Differential effect from rural to urban municipalities		X
Interaction terms to manage the influence of population variations in neighbouring municipalities on employment of SEMI-URBAN AREAS $V_U = 0$ $V_S = 1$	$\overline{\Delta UP}_{it-1} + V_S\overline{\Delta UP}_{it-1}$	Differential effect from urban to semi-urban municipalities		X
	$\overline{\Delta SP}_{it-1} + V_S\overline{\Delta SP}_{it-1}$	Differential effect from semi-urban-to-semi-urban municipalities		X
	$\overline{\Delta RP}_{it-1} + V_S\overline{\Delta RP}_{it-1}$	Differential effect from rural to semi-urban municipalities		X
Interaction terms to manage the influence of population variations in neighbouring municipalities on employment of RURAL AREAS $V_U = 0$ $V_S = 0$	$\overline{\Delta UP}_{it-1}$	Differential effect from urban to rural municipalities		X
	$\overline{\Delta SP}_{it-1}$	Differential effect from semi-urban to rural municipalities		X
	$\overline{\Delta RP}_{it-1}$	Differential effect from rural-to-rural municipalities		X

Source: Own elaboration

4.5.- Results

4.5.1 Estimation characteristics (robustness)

To ensure the robustness of our model, we have conducted various estimations, as summarized in Table 4.7. Initially, a classical model, similar to that proposed by Boarnet (1984), was employed (refer to columns 1 and 2 in Table 4.7). In this model, rooted in equations (20) and (21), the local employment area is regarded as the reference, implying that influences beyond this specific zone are not taken into consideration. It's essential to note that Boarnet's model does not differentiate among the various types of municipalities comprising this area, treating them as a homogenous collective without urban typology distinctions. Consequently, the capacity to estimate influences while distinguishing the three categories of municipalities (urban, rural, or intermediate) is constrained within this framework.

The second model estimation (columns 3 and 4 in Table 4.7) draws from the research by Alamá et al. (2022). In this model, the interactions between population and employment are limited within the local employment area. Notably, in contrast to the prior model, this approach introduces a differentiation based on the urbanization status of the municipalities within the local area. Therefore, the spillovers effects depend on the specific category of urbanization of the municipalities that are neighbors of the reference municipality, which is a distinctive feature of this model.

The third model (columns 5 and 6) is the most complex and draws its based on the work of Feser and Isserman (2017). In this model, interaction effects are introduced, thereby accounting for the heterogeneity among municipalities both at the source and the destination. All inter-municipal relationships are examined in terms of urbanization levels, thereby making a distinction between the urbanization level of the municipality in which the employment (population) increase and the level of urbanization of the municipality influenced by the spillover effect, which results in an increase in population (employment). This is not a gravity, origin-destination model; this model tries to estimate the different spillovers that are generated depending on the level of urbanization of the municipalities that belong to the same local employment area. For example, if employment increases in an urban area, indirect effects will be generated between that municipality and neighbouring municipalities that will result in an increase in population and whose magnitude will depend on the level of urbanization of those municipalities, whether they are urban, rural, or semi-urban. The results are shown in Table 4.7.

The findings from all three models suggest that as employment grows in a municipality, the population in that same municipality also tends to increase. In other words, people tend to move to areas where jobs are available (people follow jobs). However, the reverse pattern, where employment levels change in response to population shifts, is not as evident. With the exception of the first model, the results lack statistical significance in the other two models.

The stability of the three models is confirmed with respect to their lambda values. Nevertheless, the rejection of the first model is attributed to the significance of spillover effects on the other models, specifically distinguished by the type of urbanization prevalent in the municipality. Similarly, the rejection of the second model is grounded in the final model's affirmation of the significance of neighbouring effects. This confirmation is made while considering the municipality's typology as a relevant distinguishing factor.

Our attention will focus on the results derived from model 3. This model provides convincing evidence supporting the hypothesis that people tend to follow jobs. However, it is important to note that the hypothesis, jobs follow people, was ultimately rejected from the results.

Table 4.7 Estimation results (Rural municipalities: base case)

	Classical model with interterritorial connections		Classical model with interterritorial connections and spatial heterogeneity		Classical model with interterritorial connections and spatial heterogeneity and spatial interactions	
	Population equation (1)	Employment equation (2)	Population equation (3)	Employment equation (4)	Population equation (5)	Employment equation (6)
$\Delta E_{i,t}$	0.019*** [0.002]		0.016** [0.017]		0.013** [0.037]	
$\Delta P_{i,t}$		-0.540** [0.025]		-0.23 [0.284]		-0.215 [0.309]
$E_{i,t-1}$	0.027*** [0.000]	-0.857*** [0.000]	0.019*** [0.001]	-0.809*** [0.000]	0.017*** [0.003]	-0.813*** [0.000]
$P_{i,t-1}$	-0.765*** [0.000]	-0.263 [0.219]	-0.775*** [0.000]	-0.330* [0.061]	-0.767*** [0.000]	-0.320* [0.000]
$\overline{\Delta E}_{i,t-1}$	0.001 [0.913]					
$\overline{\Delta P}_{i,t-1}$		1.108 [0.209]				
$\overline{E}_{i,t-1}$	0.008 [0.639]					
$\overline{P}_{i,t-1}$		-0.061 [0.937]				
$\overline{UE}_{it-1}$			2.783** [0.016]		1.927*** [0.001]	
$\overline{SE}_{it-1}$			0.907*** [0.000]		0.471*** [0.000]	
$\overline{RE}_{it-1}$			-0.066*** [0.005]		0.005 [0.797]	
$\overline{UP}_{it-1}$				-85.350 [0.497]		18.081 [0.789]
$\overline{SP}_{it-1}$				2.377 [0.725]		7.080* [0.091]
$\overline{RP}_{it-1}$				-0.406 [0.605]		-0.131 [0.847]
$\overline{\Delta UE}_{i,t-1}$			3.844 [0.122]			
$\overline{\Delta SE}_{I,t-1}$			1.037*** [0.000]			
$\underline{\Delta RE}_{I,t-1}$			-0.106*** [0.000]			
$\overline{\Delta UP}_{I,t-1}$				-297.095 [0.342]		
$\overline{\Delta SP}_{I,t-1}$				-13.242 [0.619]		

$\overline{\Delta \mathrm{RP}}_{I,t-1}$		1.353 [0.159]	
SPILLOVERS FROM URBAN MUNICIPALITIES TO …			
(Base case) Rural $V_U = 0$ $V_S = 0$ $\overline{\Delta \mathrm{UE}}_{i,t-1}$			2.360** [0.032]
Urban $V_U = 1$ $V_S = 0$ $V_U \overline{\Delta UE}_{it-1}$			0.885 [0.815]
Semi-urban $V_U = 0$ $V_S = 1$ $V_S \overline{\Delta UE}_{it-1}$			-5.071*** [0.001]
SPILLOVERS FROM SEMIURBAN MUNICIPALITIES TO…			
(Base case) Rural $V_U = 0$ $V_S = 0$ $\overline{\Delta \mathrm{SE}}_{I,t-1}$			0.311*** [0.005]
Urban $V_U = 1$ $V_S = 0$ $V_U \overline{\Delta SE}_{it-1}$			0.451 [0.656]
Semi-urban $V_U = 0$ $V_S = 1$ $V_S \overline{\Delta SE}_{it-1}$			-0.545** [0.033]
SPILLOVERS FROM RURAL MUNICIPALITIES TO…			
(Base case) Rural $V_U = 0$ $V_S = 0$ $\overline{\Delta \mathrm{RE}}_{i,t-1}$			-0.017 [0.182]
Urban $V_U = 1$ $V_S = 0$ $V_U \overline{\Delta \mathrm{RE}}_{i,t-1}$			-0.094 [0.360]
Semi-urban $V_U = 0$ $V_S = 1$ $V_S \overline{\Delta \mathrm{RE}}_{i,t-1}$			-0.025 [0.456]
SPILLOVERS FROM URBAN MUNICIPALITIES TO …			
(Base case) Rural			

$V_U = 0$ $V_S = 0$ $\overline{\Delta UP}_{I,t-1}$				-62.068 [0.593]
Urban $V_U = 1$ $V_S = 0$ $V_U\overline{\Delta UP}_{it-1}$				-13.416 [0.981]
Semi-urban $V_U = 0$ $V_S = 1$ $V_S\overline{\Delta UP}_{it-1}$				95.436 [0.647]
SPILLOVERS FROM SEMIURBAN MUNICIPALITIES TO				
(Base case) Rural $V_U = 0$ $V_S = 0$ $\overline{\Delta SP}_{I,t-1}$				6.501 [0.450]
Urban $V_U = 1$ $V_S = 0$ $V_U\overline{\Delta SP}_{it-1}$				24.498 [0.844]
Semi-urban $V_U = 0$ $V_S = 1$ $V_S\overline{\Delta SP}_{it-1}$				11.872 [0.626]
SPILLOVERS FROM RURAL MUNICIPALITIES TO				
(Base case) Rural $V_U = 0$ $V_S = 0$ $\overline{\Delta RP}_{I,t-1}$				0.897 [0.181]
Urban $V_U = 1$ $V_S = 0$ $V_U\overline{\Delta RP}_{it-1}$				1.416 [0.853]
Semi-urban $V_U = 0$ $V_S = 1$ $V_D\overline{\Delta RP}_{it-1}$				-1.801 [0.389]
URBAN			-3.415*** [0.000]	-34.364 [0.282]
SEMIURBAN			0.716*** [0.000]	-4.052 [0.130]
shpop16	-0.805*** [0.000]	-0.831*** [0.000]	-0.880*** [0.000]	
shpob65	-2.118***	-1.909***	-1.909***	

	[0.000]		[0.000]		[0.000]	
shextr	0.663***		0.478***		0.478***	
	[0.000]		[0.000]		[0.000]	
densp	0.009***	0.060***	0.008***	0.034***	0.009***	0.034***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
of_banc	-0.001***		-0.001***		-0.001***	
	[0.001]		[0.000]		[0.000]	
tasa_paro	-0.257***		-0.305***		-0.268***	
	[0.000]		[0.000]		[0.000]	
km_Badajoz	-0.008***	-0.027***	-0.009***	-0.02	-0.008***	-0.029***
	[0.000]	[0.000]	[0.000]	[0.162]	[0.000]	[0.002]
Num coop	0.187***	-0.041	0.411***	0.607	0.296***	1.778*
	[0.000]	[0.808]	[0.000]	[0.720]	[0.000]	[0.091]
diver_shan		-0.211***		-0.225***		-0.235***
		[0.000]		[0.000]		[0.000]
densemp		0.019***		0.017***		0.017***
		[0.000]		[0.000]		[0.000]
lrenta		0.596***		0.312**		0.349**
		[0.001]		[0.043]		[0.020]
Constant	5.787***	4.999	4.984***	5.119	5.178***	-3.084
	[0.000]	[0.382]	[0.000]	[0.668]	[0.000]	[0.693]
Observations	1,496	1,496	1,870	1,870	1,870	1,870
R-squared	0.749	0.586	0.69	0.543	0.71	0.546

Source: Own elaboration

4.5.2 Local growth factor variables (Territorial variables)

Variables affecting local population and employment growth are describe in table 4.1 (description of variables) and Table 4.2 (main statistics). In relation to population change equation, basically all are statistically significant and in the most part of variables takes the expected sign.

The variables associated with age groups, specifically *shpop16* and *shpob65*, have exhibited statistical significance with a negative coefficient, (as in de Graaff, 2012). Moreover, the presence of a positive coefficient in the case of the foreign population variable suggests that immigrants play a role in augmenting the population growth of municipalities. In examining the variable of population density, its positive coefficient aligns with our expectations, indicating that areas with higher population density are perceived as more attractive. Conversely, the unemployment rate proxy reveals a negative coefficient, implying that it serves as a measure of local dynamism, where lower unemployment rates render a municipality more appealing to the working-age population. Lastly, the variable measuring accessibility, specifically 'distance to the main city,' exhibits the anticipated sign, with a negative coefficient. This suggests that municipalities closer to the main city are regarded as more attractive to the population.

In the context of the employment change equation, we observe several noteworthy results. First, as in the population equation, proximity to the main city presents a negative and statistically significant coefficient. This signifies that, within this analytical framework, increased distance from the primary urban center is associated with reduced employment growth in local areas.

Furthermore, the industrial diversity index assumes a negative coefficient, signifying an inverse relationship between industrial diversity and employment growth. Specifically, as industrial diversity expands, employment growth contracts. This observation suggests that, within this particular context, higher industrial diversity does not appear to be a magnet for employment generation in local regions.

Conversely, the employment density variable maintains a positive coefficient, aligning with our expectations. This suggests that areas with a greater concentration of employment opportunities tend to experience increased employment growth.

In addition, the income per capita variable, serving as a proxy for economic activity, exhibits a positive and statistically significant coefficient. This indicates that regions with higher income per capita tend to foster enhanced employment growth. In essence, a rise in economic activity, as measured by income per capita, is positively associated with employment expansion in the given local context.

The variable representing social economic activity, specifically the number of cooperatives, exhibits a noteworthy and substantiated positive parameter, a trend observed consistently in both population and employment change equations. This finding holds particular significance within the context of rural areas, offering profound insights into the resilience of the social-economic fabric in regions that face depopulation risk or are classified as “left behind places”. The positive and statistically significant coefficient associated with the number of cooperatives underscores the crucial role that cooperative enterprises play in these rural locales. It implies that, as the number of cooperatives increases, there is a concurrent upswing in both population and employment. This is indicative of a socio-economic environment that not only resists the challenges of depopulation but, intriguingly, thrives in such conditions. This robust and affirmative relationship between cooperatives and demographic and labour force dynamics suggests that these community-driven, cooperative structures contribute significantly to the economic and social sustainability of rural areas. Their presence may help counteract the adverse effects of depopulation and the categorization of areas as “left behind”, serving as vital agents of local development and social cohesion. In essence, the positive parameter associated with the number of cooperatives sheds light on the resilience and adaptability of these regions, indicating that the proliferation of cooperative ventures represents a compelling strategy for addressing the socio-economic challenges faced by rural municipalities at risk of depopulation and neglect.

4.5.3 Interterritorial connections

The primary objective of this study is to investigate interterritorial linkages among local areas, with a focus on their degree of urbanization. Tables 4.5, 4.6, and 4.7 summarize the interterritorial connections analysed in this study, providing a basis for detailed examination.

With respect to the interterritorial relationships, the estimated coefficients are shown in Tables 4.8 and 4.9. From table 4.8 (the influence of neighbouring employment variation on local population variation), three results should be highlighted. First, the negative influence of neighbouring employment variation from urban municipalities on semi-urban population variation (-2.71*). Second, the positive influence of neighbouring employment variation from urban (2.36**) and semiurban municipalites (0.311**) on rural population variation.

In the first case, the presence of backward effects, denoted by a negative sign, strongly implies that the influence exerted by urban municipalities on semi-urban municipalities is by nature competitive. In other words, instead of benefiting semi-urban municipalities, the influence of urban areas has negative effects, indicating a competitive dynamic between these two types of municipalities. Semi-urban municipalities are areas characterized by being located at the nexus of urban and rural attributes, presenting a mixture of characteristics of both zones. The presence of negative outcomes underscores that these semi-urban municipalities are affected by the actions and influences of urban areas, resulting in a competitive landscape where interests, resources or development priorities may conflict. This not only highlights the nature of their positioning, but also underscores the need for a comprehensive understanding of the interaction between urban and semi-urban municipalities to address the challenges arising from this competitive influence.

Conversely, the impact of variations in employment within urban and semi-urban areas engenders a positive influence, specifically in the form of "spread effects," on rural municipalities. This outcome implies that alterations in employment levels in urban and semi-urban regions yield favorable consequences for rural municipalities. Given that rural areas typically exhibit lower population density and a concentration on agriculture or natural resource-based activities, they appear to derive benefits from the shifts in employment occurring in urban and semi-urban areas.

In the case of the impact of population on employment (i.e., jobs follow people), the results, as discussed in the context of Table 4.7, are not significant (table 4.9).

The analysis of intermunicipal relationships is complex and involves many aspects that should be taken into account in order to obtain efficient results and to be able to establish political or technical recommendations. It is logical that the more elements are introduced, the more complex the models become, both technically and in terms of interpretation of the results.

Table 4.8 Influence of neighbouring employment variation on local population variation (population equation).

	Population changes in municipalities		
employment change of surroundings areas	**Urban**	**Intermediate**	Rural
Urban	3.244	−2.71*	2.36**
Semi-urban	0.762	−0.233	0.311**
rural	−0.110	−0.042	−0.017

Source: Own elaboration

Table 4.9 Influence of neighbouring population change on local employment change (employment equation)

	Employment changes in municipalities		
Population changes of surroundings areas	**Urban**	**Intermediate**	**Rural**
Urban	-75.84	33.35	-62.07
Semi-urban	30.99	18.37	6.501
rural	2.313	-0.903	0.897

Source: Own elaboration

4.6.- Conclusions

The findings of our study shed light on the dynamics of interterritorial connections and the influence of employment variations on local population and employment growth. The robustness of our model, as evidenced by lambda values, underscores the reliability of the results obtained through various estimations. The initial specification of the models proposed by Boarnet (1994) and Alamá et al. (2022a), model, is improve following the approach proposed by Feser and Isserman (2006) and Alamá et al. (2022b), where the significance attributed to spillover effects and neighbouring influences are highlighted.

The primary conclusion drawn from the results is that, across all three models, a consistent pattern emerges: as employment increases in a municipality, the local population also tends to rise. This aligns with the principle of "*people follow jobs*". However, the reverse relationship, where employment levels respond to population shifts, lacks statistical significance in the latter two models. Therefore, our focus shifts to the outcomes derived from the third model, which provides compelling evidence supporting the hypothesis that people indeed tend to follow jobs. It is essential to note, however, that the hypothesis suggesting "jobs follow people" is not supported by the empirical findings.

Beyond the estimation characteristics, our exploration of local growth factor variables clarifies the multifaceted determinants of population and employment changes. Variables such as age groups, foreign population, population density, approximate unemployment rate, and distance to the main city show expected signs and statistically significant coefficients, providing relevant perspective on the interaction of these factors in shaping local dynamics.

In the context of the employment change equation, noteworthy observations include the negative influence of proximity to the main city on employment growth, indicating the importance of urban centers in driving local economic activities. The inverse relationship between industrial diversity and employment growth suggests that, in this specific context, a more diversified industrial landscape does not necessarily correlate with increased employment. Conversely, the positive impact of employment density, income per capita, and the number of cooperatives signifies the importance of concentrated employment opportunities, economic activity, and cooperative enterprises in fostering employment growth. The relevance of the social economy for Extremadura has been highlighted by the positive effect that the presence of this type of entities within the municipalities shows for both equations: population and employment. Therefore, social economy can be a crucial aspect in the fight against depopulation in Extremadura.

The last aspect of our analysis delves deeper into inter-territorial connections, underlining the importance of considering the degree of urbanization to understand local dynamics. Detailed examination of inter-municipal relationships reveals patterns, such as negative influences of urban municipalities on semi-urban population variation and positive influences of urban and semi-urban municipalities on rural population variation.

According to the results obtained, when evaluating the hypothesis on the connections between spatial interactions and territorial structure, we observe that spatial interactions between the different types of municipalities are relevant. Specifically, the population in rural municipalities is determined by the employment of both urban and semi-urban areas located at a certain distance. Therefore, we can conclude that "the population in Extremadura's rural municipalities follows the employment in their nearby urban and semi-urban municipalities". The effects generated by the change in employment in semi-urban and urban areas have a positive impact on the population growth of neighboring rural municipalities. Therefore, from a policy perspective against depopulation, a possible recommendation in Extremadura could be the implementation of policies focused on job creation in intermediate and urban areas to favor displacements from neighboring rural areas.

In conclusion, our study contributes valuable insights into the complex network of factors influencing population and employment dynamics at the local level. These findings have implications for policymakers, offering an understanding of the relationships between urban, intermediate, and rural areas and suggesting targeted strategies for sustainable development and mitigating depopulation risks.

4.7.- References

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CONCLUSIONES GENERALES

El objetivo principal de esta tesis ha sido el análisis de la relación entre la localización de los factores productivos regionales y la evolución económica regional. La población a nivel regional ha sido el elemento que ha vertebrado los cuatro capítulos que la configuran. Aunque las conclusiones recogidas en cada uno de los capítulos son más explícitas que el contenido que se presenta en este apartado final, en estas conclusiones generales se pretende mostrar una síntesis de las principales aportaciones de esta investigación.

El primer capítulo ha examinado la existencia de desajustes espaciales entre los factores productivos regionales y la distribución de la población en el marco del análisis las economías regionales europeas. En la base de dichos desajustes se encuentran los movimientos interregionales de población con respecto al factor trabajo y al stock de capital. La elaboración del índice denominado spatial mistmatch index (SMI), tanto para el caso del factor trabajo como para el factor capital, ha permitido medir hasta qué punto en las regiones europeas se producen estos desajustes que generan ineficiencias en el sistema económico regional, afectando a la desigualdad y al crecimiento económico. La descomposición del SMI ha permitido identificar cuál es el elemento responsable (los flujos de población o los movimientos del factor de producción correspondiente) en mayor medida, de los desajustes existentes.

Los resultados obtenidos indican que tanto el stock de capital físico como el empleo son los principales determinantes de las variaciones del SMI y, por tanto, de la convergencia o divergencia entre población y factores de producción a nivel regional. Consecuentemente, no es el movimiento de la población el determinante del cambio en los cambios del SMI. En este contexto, en las regiones europeas se han identificado dos procesos: el trabajo sigue a la población y el stock de capital físico sigue a la población.

Por otro lado, se ha realizado un análisis empírico mediante un modelo de vectores autorregresivos (VAR) con el objeto de examinar cómo los desajustes de los factores productivos (SMI) y la población afectan al crecimiento económico y a la desigualdad regional. Los resultados confirman que lograr el crecimiento económico y reducir la desigualdad no son objetivos contradictorios, dependerá de cómo se asignen los factores de producción entre las regiones. Según dichos resultados, el empleo y el stock de capital físico se complementan entre sí. Este resultado es fundamental, ya que sugiere que, al abordar las disparidades regionales, las políticas regionales que distribuyen los recursos basándose únicamente en el reparto atendiendo a criterios poblacionales no lograrán combatir las desigualdades regionales. Por el contrario, las políticas destinadas a atraer y retener mano de obra cualificada y a aumentar el stock de capital físico en las regiones rezagadas contribuirían a disminuir las desigualdades. La implicación de todo lo anterior es que debería dotarse de más recursos productivos donde menos gente hay; por lo tanto, si se pretenden reducir las desigualdades regionales, el desajuste espacial entre esos factores productivos y la población debería aumentar.

El estudio de los desajustes espaciales entre la población y los factores productivos nos ha permitido llegar a la conclusión de que, si las distribuciones regionales convergen, se producirá un aumento tanto el crecimiento económico como de la desigualdad regional. Por lo tanto, para corregir la desigualdad se propone adoptar políticas regionales que no estén basadas en criterios poblacionales. Estas políticas deberían llevar factores de producción a las regiones donde menos población existe; de esta forma, el aumento de la divergencia haría que las desigualdades regionales tiendan a disminuir. Todo ello llevaría implícitos cambios poblacionales a nivel regional, puesto que la divergencia entre ambas distribuciones impulsaría un cambio de tendencia en la población, que "seguiría" a los factores de producción (people follow jobs).

El capítulo 2 se centra en las provincias españolas. En este caso, el análisis aborda las variaciones de la población, examinando cómo estas varían según la cohorte de edad y la ubicación geográfica. El estudio se contextualiza en los "lugares vacíos" o "lugares olvidados", contribuyendo a la literatura reciente sobre despoblación. Con ello, se pretende arrojar luz sobre el reto demográfico, el cual se ha convertido en una de las líneas de actuación política más relevantes para la mayoría de las administraciones públicas a todos los niveles territoriales.

La principal aportación de este estudio es destacar la importancia del "vecino" en el análisis demográfico territorial. Para que las políticas públicas sean eficaces, se deben considerar las relaciones interterritoriales y todo lo que estas implican. En este contexto, una de las contribuciones más significativas de este trabajo ha sido la creación de una nueva tipología territorial que permite realizar diagnósticos basados en componentes demográficos. Siguiendo la metodología regional del shift-share espacial y nacional (tabla 2.9), la variación de la población entre 2015 y 2020 se ha descompuesto en componentes que miden la relevancia de las cohortes de edad y los componentes regionales. Estos componentes se utilizan para efectuar un diagnóstico específico para cada provincia, comparando su situación con la de sus vecinos y con el contexto nacional.

Como se ha señalado, la descomposición en términos nacionales (shift-share clásico) ha permitido identificar que la variación de la población en cada cohorte de edad está determinada por diferentes componentes. En consecuencia, esta variación se explica por diversos factores.

En cuanto al componente que refleja el efecto de cohorte (CME), se ha observado que la población mayor de 65 años muestra un comportamiento más favorable en comparación con el total de la población. Por el contrario, en todas las provincias, el efecto de cohorte es negativo para las demás cohortes de edad, actuando como un factor que frena el crecimiento poblacional. Esto sugiere la urgencia de implementar medidas específicas para apoyar a la población menor de 16 años y a la población en edad de trabajar (entre 16 y 65 años).

En este sentido, se recomienda adoptar medidas que faciliten la conciliación del trabajo con el cuidado infantil, así como ofrecer exenciones fiscales o subvenciones a familias con hijos. Para la población en edad de trabajar, se podrían mejorar el acceso a viviendas asequibles, la inversión en educación y capacitación laboral que permita a los trabajadores avanzar en sus carreras, y ofrecer incentivos fiscales a las empresas que contraten o retengan trabajadores.

El Componente Competitivo (CE) es el principal determinante del cambio demográfico provincial, influyendo de manera variable en los diferentes grupos de edad, según si la provincia se encuentra en una fase de crecimiento positivo o negativo. Durante el periodo 2015-2020, si una provincia ha registrado un crecimiento positivo, este factor actúa como la principal fuente de dicho crecimiento. Por el contrario, si una provincia ha experimentado un crecimiento negativo, el efecto competitivo refleja esa pérdida de competitividad, frenando la capacidad de crecimiento de la población. En este sentido, las políticas regionales deberían centrarse en mejorar este componente en las provincias en declive para atraer nuevos residentes, aumentar la competitividad e impulsar el crecimiento de la población.

Tal y como se ha señalado, los flujos de población entre provincias vecinas son constantes y ocurren por distintos motivos. Por lo tanto, un estudio de las variaciones de población debe considerar el contexto geográfico. Lo que sucede en las provincias vecinas es una parte importante del análisis demográfico y debe ser incluido en el estudio de la población. El análisis shift-share espacial ha permitido incorporar este elemento espacial mediante dos contextos: Vecindario (NC) y Regional (RC). Estos contextos han sido utilizados para analizar los efectos de la cohorte de edad y el componente competitivo.

Los resultados han mostrado que, al igual que en el análisis shift-share clásico, cuando se estudia el efecto de la cohorte de edad (contexto vecindario, NCM, y contexto regional, RCM), los grupos de población con mayores desventajas en todas las provincias son los menores de 16 años y la población entre 16 y 65 años. Por lo tanto, deberían adoptarse políticas interterritoriales y regionales adaptadas a cada cohorte de edad. En contraste, el grupo de edad formado por los mayores de 65 años es el único que presenta un efecto de cohorte positivo tanto en el contexto vecindario como en el regional.

El efecto competitivo en el análisis shift-share espacial (contexto vecindario, NCE, y contexto regional, RNE) ha permitido generalizar que, para todos los grupos de edad, es positivo en aquellas provincias donde la población ha crecido durante el periodo 2015-2020. Por el contrario, si la provincia ha experimentado un crecimiento negativo, este efecto competitivo también es negativo. Esto sugiere la necesidad de desarrollar políticas competitivas regionales que estimulen el crecimiento general de la población, adaptándose a grupos de edad particulares (políticas competitivas sectoriales) cuando los efectos competitivos con las provincias vecinas sean adversos.

Como se ha visto, el análisis es complejo y presenta múltiples aristas que deben considerarse. Sin embargo, esta complejidad constituye la principal aportación de este capítulo: la identificación de las diversas fuentes de crecimiento de la población y la necesidad de abordarlas en el contexto adecuado. Este nuevo enfoque podría ser clave para enfrentar el reto demográfico en contextos geográficos locales y adaptados a las características específicas de cada territorio.

En el capítulo 3 el contexto geográfico de análisis sigue siendo las provincias españolas, pero en este caso, se aborda una cuestión distinta, cuyo hilo conductor siguen siendo las características poblacionales. En este caso utilizamos la clasificación de Eurostat de municipios urbanos, semiurbanos y rurales (Dijkstra y Poleman, 2014) con el objetivo de determinar la estructura poblacional que potencia el desarrollo regional. Investigamos en qué medida las diferencias en el nivel de urbanización de las regiones/provincias contribuyen a su crecimiento económico.

Nuestro estudio enlaza con las teorías del Crecimiento Endógeno y de la Nueva Economía Geográfica por la gran atención que prestan a la urbanización y sus efectos en el crecimiento de la zona urbanizada (Lucas, 1988; Romer, 1994) y en la productividad (Fujita, Krugman y Venables, 1999; Fujita y Thisse, 2002). También en la última década Duranton y Puga (2002, 2014, 2019) o Desmet, Nagy y Rossi-Hansberg (2018) inciden en la relación entre crecimiento de las ciudades y el crecimiento económico.

En este contexto, Williamson (1965) puso de manifiesto la conexión entre el nivel de desarrollo de un país y el impacto de la aglomeración urbana en el crecimiento económico formulando su hipótesis: en las primeras etapas del desarrollo económico la disyuntiva entre eficiencia y equidad está presente, pero deja de estarlo después de un cierto nivel de desarrollo, afectando incluso negativamente a la eficiencia. Investigadores como Brülhart y Sbergami (2009), Wheaton y Shishido (1981) y Aroca et al. (2014) han estimado el nivel de renta per cápita a partir del cual la aglomeración deja de estimular el crecimiento económico.

En nuestro análisis se considera la tipología de los municipios de cada provincia, en cuanto a la clasificación entre municipios rurales, semi-urbanos y urbanos. En este sentido, se calcula la proporción de población urbana y semi-urbana que existe en cada provincia. A nivel metodológico, son dos los niveles de análisis que se pueden detectar en este capítulo. En primer lugar, se plantea un modelo de crecimiento económico en el que se estiman los parámetros de las principales variables: la proporción de población urbana y la proporción de población semi-urbana en cada provincia española.

Con los parámetros estimados y después de realizar el correspondiente análisis se significatividad, se aborda un ejercicio de optimización, cuyo objetivo es determinar los efectos que la proporción de población urbana y semi-urbana ejercen sobre el crecimiento de la población. Es decir, el principal objetivo es determinar la elasticidad del crecimiento económico en función de la proporción de población urbana y semi-urbana. La propia definición del modelo en la primera fase hace que dicha elasticidad dependa tanto de la proporción de población (urbana / semi-urbana) como del PIB per cápita.

Por lo tanto, tenemos tres variables con las que estimamos un punto óptimo que permite detectar lo cerca o lejos que están las provincias españolas de dicho punto óptimo.

El análisis de optimización también ha permitido determinar dos umbrales de población: uno referente a la población urbana y otro para la población semi-urbana. Así, se ha enlazado con la hipótesis de Williamson y se ha estudiado si, en el caso de las provincias españolas, existe un umbral de población urbana y semi-urbana más allá del cuál el efecto del aumento de la población genera efectos negativos en el crecimiento económico. Los resultados obtenidos han demostrado que las concentraciones de población urbana pueden llegar a generar economías de aglomeración, pero a partir de cierto nivel sus efectos positivos decrecen; sin embargo, la población en áreas semi-urbanas, no tiene efectos negativos sobre el crecimiento económico, por lo que no se confirma la hipótesis de Williamson para las concentraciones de la población semi-urbana.

En resumen, la investigación revela que los porcentajes de población urbana afectan negativamente al crecimiento económico a partir de ciertos umbrales, mientras que los porcentajes de población semiurbana influyen positivamente en el crecimiento. Este resultado sugiere la importancia de mantener un equilibrio óptimo entre las poblaciones urbana y semiurbana para maximizar el desarrollo económico. El estudio subraya la importancia de la planificación urbana estratégica y la necesidad de gestionar los efectos de la urbanización para evitar la congestión y otros problemas relacionados con las ciudades. Además, las zonas semi-urbanas ofrecen potencial de crecimiento económico sin los inconvenientes asociados a los altos niveles de urbanización.

El conocimiento de la contribución de un tipo determinado de población (urbana o semiurbana) al crecimiento económico regional, sin duda, proporciona información valiosa a la hora de diseñar estrategias efectivas que promuevan el desarrollo regional.

Entre las estrategias para abordar el desarrollo regional, cobran cada vez más importancia las conexiones interterritoriales por las ventajas y beneficios que ofrecen. Las áreas locales pueden desbloquear importantes opciones de desarrollo, como se reconoce desde el marco del desarrollo neo-endógeno, que enfatiza la necesidad de cooperación y coordinación regional para abordar los desafíos compartidos, capitalizar los recursos colectivos y aprovechar las fortalezas complementarias. Desde este enfoque se fomenta la colaboración entre localidades adyacentes para mejorar la cohesión territorial, promover sinergias y facilitar iniciativas conjuntas que puedan conducir a resultados de desarrollo más sostenibles y equilibrados. Bajo este planteamiento, el Capítulo 4 aborda las relaciones entre la población y el empleo, factores clave en el desarrollo de los “left behind places”, que es un objetivo principal de las actuales políticas de desarrollo regional (Rodriguez-Pose, 2018; MacKinnon et al., 2022). Conocer las conexiones entre empleo y población permite diseñar actuaciones que revitalicen esos “lugares dejados atrás” y en esa revitalización, las entidades de la economía social juegan un papel muy importante, al ser impulsoras de la actividad económica en las regiones rurales.

En este capítulo, nos centramos en el ámbito municipal. En concreto, el objetivo principal de este último capítulo de la tesis es investigar la dinámica interterritorial entre municipios rurales, urbanos y semiurbanos de la Comunidad Autónoma de Extremadura a partir de un modelo de ecuaciones simultáneas en el que las variables endógenas son el crecimiento de la población y del empleo. Se analizan, los efectos externos (spillovers), bien sean positivos (spread) o negativos (backwash) que generan las áreas urbanas o semi-urbanas sobre los municipios rurales. Además, mediante la inclusión de una variable que mide el número de cooperativas a nivel territorial, se intenta conocer la contribución de la economía social a la resiliencia de la población y del empleo.

Nuestro modelo se basa en las ecuaciones simultáneas propuestas por Carlino y Mills (1987), Boarnet (1994) y Feser e Isserman (2006) en las que el crecimiento de la población y del empleo se consideran variables endógenas y se tienen en cuenta también los efectos difusión o contracción que estas variables generan entre municipios adyacentes en función de su nivel de urbanización. Así, nuestra hipótesis principal es comprobar si los efectos indirectos generados por las relaciones interterritoriales entre municipios son independientes del nivel de urbanización, ya que dicho conocimiento justificaría la orientación de la política territorial hacia los centros de empleo con mayores efectos indirectos en el territorio.

La conclusión principal es que a medida que aumenta el empleo en un municipio, la población local tiende a aumentar, lo que apoya la hipótesis de que “las personas siguen a los trabajos” y respecto de las relaciones intermunicipales, se confirman las influencias positivas de los municipios urbanos y semiurbanos en la variación de la población rural aunque también aparecen la influencias negativas de los municipios urbanos en la variación de la población semiurbana, lo cual podría deberse a la relación de competitividad que surge entre ambos.

Respecto a las variables que afectan al crecimiento de la población y el empleo a nivel local, los resultados confirman en términos generales la significatividad estadística y el signo esperado de las variables que las afectan.

La consideración de la economía social a través del número de cooperativas en ambas ecuaciones pone de manifiesto la importancia de su presencia en el ámbito rural, contribuyendo significativamente y de forma positiva a la sostenibilidad económica y social del mismo. La presencia de entidades de economía social influye positivamente tanto en el crecimiento de la población como del empleo, lo que pone de relieve su papel en la lucha contra la despoblación. El estudio también subraya la importancia de comprender las relaciones intermunicipales y los grados de urbanización para fundamentar las políticas de desarrollo local.

Con los resultados de este último capítulo se pone de manifiesto la importancia de las relaciones interterritoriales en los "lugares olvidados", sugiriendo estrategias para la formulación de políticas que luchen por el desarrollo sostenible y contra la despoblación.

En conjunto, estos estudios sugieren que abordar los desajustes espaciales, optimizar la distribución de la población urbana y semiurbana y potenciar las conexiones interterritoriales es fundamental para el desarrollo regional sostenible. Futuras investigaciones deberían centrarse en replicar los trabajos aquí presentados a otras áreas geográficas. No obstante, y para los casos analizados, los responsables políticos deberían tener en cuenta las siguientes directrices generales derivadas de esta investigación:

-Aplicar políticas específicas para ajustar la mano de obra y el capital físico con las distribuciones poblacionales regionales en función de los objetivos perseguidos (equidad regional o crecimiento agregado).

-Desarrollar políticas demográficas globales para apoyar a la población joven y en edad de trabajar.

-Gestionar la urbanización para mantener un equilibrio entre las zonas rurales, urbanas y semiurbanas que estimule el crecimiento económico.

-Analizar las relaciones que se den dentro de un sistema económico regional entre las distintas tipologías urbanas para estimular aquellas tipologías más beneficiosas en términos de población y empleo.

-Promover iniciativas de economía social para apoyar el crecimiento de la población y el empleo en las zonas rurales y semiurbanas.