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Italian migration and its demographic and socio-economic aspects. Three case studies.

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To my daughters, Giulia and Alessandra

"(…) moving across space is a «prerogative» of human beings; it is an integral part of their «capital», an additional capability through which living conditions may be improved. It is an inherent quality that has made possible the survival of hunters and gatherers, the dispersal of humankind across continents, the spread of agriculture, the settlement of empty spaces, the integration of the world, and the first wave of nineteenth-century globalization"

(Translated by the author from Livi-Bacci, 2010)

Summary and motivation

Migration has always been a way to seek a better life elsewhere. But today, in an era in which borders, technologies, and rules change faster than individual biographies, migration is also a choice exposed to new uncertainties that are less transparent and less governable. People do not move only for work, study, or family: they move in response to incentives, constraints, and expectations that are constantly changing and are not always visible to those who remain in place. My thesis attempts to go beyond measuring flows and focuses more on who moves, where they go, what they leave behind and what they take with them, and how all this translates into new demographic and territorial balances (or imbalances).

The three studies that make up my doctoral thesis address the issue of migration as a mechanism for redistributing population and human capital, following three distinct but complementary empirical paths: how we react when the rules change (Brexit), how the geography of aging is being reorganized (internal and international migration), and how to measure the loss or gain of human capital using alternative tools (brain drain).

The first study shows that a border does not need to actually close in order to change the behavior of those who intend to cross it. Sometimes, the mere shadow of change is enough. The 2016 referendum in the United Kingdom (Brexit) did not immediately change immigration laws, but it did create a climate of uncertainty that prompted many potential migrants from Italy to rethink their plans, preferring other countries. This effect, which we call *migration diversion*, is not uniform: it has a greater impact among Italian migrants with lower levels of education, who are less likely to be accepted under the future British points-based system. Migration, therefore, is not only a reaction to material conditions, but also a response to political signals.

The second study shifts focus to national borders to examine whether migration slows down or accelerates the aging process of a territory. The result is twofold: Italy as a whole is converging towards an older demographic structure, and in this context, migration does not level but reorganizes. Young adults are concentrated in metropolitan areas and economically dynamic zones; peripheral municipalities, deprived of the working population, are aging more rapidly. Immigration from abroad helps to slow this process, but it is not enough to reverse it.

The third study addresses a common misconception: that Italy is experiencing a “brain drain.” But losing what, and compared to whom? Measuring brain drain only by counting those who leave means ignoring those who return, those who arrive, and those who move within the country's borders. By comparing these flows with the reference populations, a more complex

picture emerges: the country is not experiencing a net loss of human capital, but the balance is highly cyclical and, above all, asymmetrical. The North attracts graduates from the South, offsetting losses abroad; the South faces a double exodus; graduated foreigners contribute to the rebalancing, but do not bridge the gap in terms of relative skills per worker. Rather than an exodus, it is a selective redistribution.

Read together, these three essays offer a broader perspective: migration is a structural process that must be governed with territorial precision. If policy changes, the direction of departures changes. If opportunities in the territories change, the map of aging changes. If the lens through which we measure changes, the perception of loss or gain changes. The challenge for research and public policy is therefore twofold: not to stop mobility, but to guide it; and not to fear it, but to understand it.

These three perspectives constitute the analytical foundation of my thesis. The following chapters formalize this narrative by presenting the theoretical framework of migration, identifying the research gaps that motivate each contribution, and situating the empirical analyses within the Italian context. This structure clarifies how the three studies form a coherent investigation of migration as a redistributive process.

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Chapter 1. An overview of migration: the Italian case

Migration can be understood as a redistributive mechanism: a process through which people and human capital are reallocated across space in response to economic opportunities, institutional changes, and demographic pressures. This perspective provides the unifying lens of the thesis. Although the three empirical studies address different questions: responses to policy shocks, the reorganization of territorial aging, and the measurement of human-capital (loss or gain), they all examine how migration reshapes demographic and socio-economic structures across territories.

Mobility and migration are integral components of human experience and can be regarded, in every respect, as "total social facts", because they cut across all stages and dimensions of individual and collective life. Recent technological advances have made transport faster and more accessible, thereby progressively expanding the freedom to move through space. The implications of these phenomena extend well beyond the individual who moves, affecting a constellation of interdependent spheres: the family, the housing and labor markets, and the organization of territory.

According to Kaufmann (2002), migration represents a specific form of mobility, alongside daily and residential mobility, and is distinguished from them by the duration and depth of the territorial and social discontinuity it entails. While daily and residential mobility involve short-distance or within-area movements embedded in routine life-course adjustments, migration implies crossing broader socio-cultural, administrative, and symbolic boundaries. For this reason, migration constitutes the most complex form of mobility and the one with the strongest redistributive effects on population and human capital across space.

This chapter will proceed as follows: Section 1.1 describes the context of Italian migration; Section 1.2 provides an overview of the main theories and determinants of migration; Section 1.3 explores some gaps not widely addressed in the existing literature and the contributions of this thesis to address them; Section 1.4 presents the objectives of the thesis and the methodologies adopted; and Section 1.5 concludes.

1.1 Context of Italian migration

Italy offers an ideal setting for studying migration dynamics because it combines emigration, immigration, and internal mobility. Few countries display all three forms of movement with such intensity and persistence, and even fewer exhibit how they interact with a long-standing territorial dualism between the Mezzogiorno and the Centre–North. This coexistence makes Italy a privileged observatory for examining how migration redistributes people and human capital across space.

After the mass-emigration cycle of the late 19th century to the 1960s and the subsequent stabilization until the 1990s, Italian emigration accelerated again from the mid-2000s, especially after the 2008–2013 crisis. These renewed outflows differ considerably from earlier waves: they involve younger adults and graduates, rely heavily on low-threshold intra-EU mobility, and are shaped by skill–demand mismatches, labor segmentation, and low entry wages at home. On the pull side, knowledge ecosystems, sectoral clusters, and the institutional facilitation of qualification recognition (Directive 2005/36/EC) increase the returns to migration (OECD, 2024; Docquier and Rapoport, 2012). Integration abroad follows a dual pattern: high-skilled movers enter R&D, health, universities, ICT, engineering, finance, and design hubs, while medium-/low-skilled profiles cluster in hospitality, logistics, construction, and care. Among graduates, mismatch tends to decline within 1–5 years due to language acquisition, certifications, and job switching; trajectories include returns and re-emigration (AlmaLaurea, 2024; Tintori, 2017).

Geographically, outflows originate disproportionally from the Mezzogiorno and from Northern university/metropolitan hubs, while destinations cluster in major European and extra-European cities (Istat, 2024). Networks reduce entry barriers and foster stepwise migration; without upskilling, however, they may confine movers to low-mobility niches (Tintori, 2017). These patterns produce asymmetric territorial impacts: cumulative human-capital losses in the Mezzogiorno and gains in Northern metropolitan areas through global networks activated by expats (Murat and Pistoresi, 2007).

These dynamics are particularly important for understanding how Italian emigrants reacted to the uncertainty triggered by the 2016 Brexit referendum. Although the referendum did not immediately alter entry conditions, it generated a sharp rise in institutional uncertainty regarding future access to the UK. This uncertainty changed the expected costs and benefits

of moving, especially for individuals with lower levels of education who anticipated being more exposed to future restrictions under a points-based system. As a result, part of the Italian outflow that would have targeted the UK was diverted toward alternative destinations. This redirection reflects a form of anticipatory behavior: migrants responded not to enacted reforms, but to the expectation that rules could soon become more restrictive.

Chapter 2 examines this mechanism in detail by quantifying how the Brexit referendum reshaped emigration patterns from Italy before any policy change took effect. The chapter shows that uncertainty alone can alter destination choices and selectively affect different educational groups, revealing how institutional signals influence international mobility even in the absence of formal legal barriers.

The selective patterns matter not only for destination choices but also for Italy's long-term human-capital balance. Chapter 4 returns to this issue by assessing how much skill loss Italy effectively experiences through youth outmigration, taking into account returns, internal redistribution, and foreign inflows. Understanding emigrants' responses to institutional uncertainty is therefore essential for situating Italy's net human-capital dynamics within a broader redistributive framework.

Within national borders, interregional mobility continues to follow a marked South towards Center-North gradient, reframing the "*Questione meridionale*." Since the 2000s, selective movements of young people, often graduates, have grown toward metropolitan hubs and manufacturing/service regions with strong labor demand (Lombardy, Emilia-Romagna, Veneto, Tuscany, and Lazio). Universities act as a hinge, studying away from home anticipates permanent moves, and internal brain drain penalizes especially female graduates, widening gender and human-capital gaps (Viesti, 2019). At destination, high-skill profiles enter advanced services, research, ICT, and health, while medium-skill flows feed logistics, hospitality, construction, and personal services. Initial mismatch eases with certifications, networks, and job switching, but persists for those entering via informal channels. For origin areas, selective outflows in childbearing ages accelerate depopulation and aging, depress qualified demand, and weaken investment absorption capacity, fueling further departures that returns migration does not offset. Family and friendship networks reduce transition costs but may crystallize low-mobility paths unless coupled with upskilling and stronger local demand.

These patterns are central for understanding how Italy's age structure is being redistributed across space. Internal mobility is highly selective: those who leave the Mezzogiorno for the Centre–North, and those who move from peripheral to metropolitan areas, are predominantly young adults and graduates. As a result, origin areas lose individuals in the very ages that sustain fertility, employment, and tax capacity, while destinations receive a demographic inflow that slows aging and supports local labor markets. Therefore, selective internal mobility is a key driver of territorial divergence in population aging. Chapter 3 examines this mechanism in detail by quantifying the contribution of both internal and international migration to the convergence or divergence of aging across Italian municipalities. By decomposing the sources of demographic change, the chapter shows how mobility accelerates aging in some areas while mitigating it in others, revealing the extent to which migration acts as a redistributive force on the spatial organization of demographic structures.

The selective internal movements also have important implications for the distribution of human capital. Chapter 4 incorporates internal mobility, together with emigration, returns, and foreign inflows, into a stock–flow–consistent measure of human-capital redistribution, showing how regional skill balances depend not only on who leaves and who arrives, but also on where individuals relocate within the country.

Turning to immigration (Italy's other major component of population change) its demographic and spatial effects are equally important for understanding the redistributive mechanisms analyzed in this thesis.

Italy gradually shifted from emigration to immigration country between the 1980s and the 2000s through the interplay of three forces: internal demographic dynamics (low fertility and rapid aging), sectoral labor demand, and the progressive institutionalization of entry channels. After a long postwar period dominated by outflows, from the 1980s onward there were steady inflows of workers and family reunifications, with marked territorial asymmetries: metropolitan areas and the North proved more attractive thanks to their productive structure, migrant networks, and service endowments. On the regulatory side, alternating quotas and regularizations unfolded within a segmented labor market permeated by informal channels, while the 2004–2007 EU enlargements expanded intra-European mobility (Bonifazi, 2007; Bonifazi and Heins, 2017; Pugliese, 2002).

Demographically, foreign immigration contributes to births primarily via age structure: upon arrival, births are first postponed and then "caught up", followed by convergence toward native patterns, with differences by origin and birth order (Mussino and Strozza, 2012).

Economically, labor-market integration is highly segmented and concentrated in low-protection sectors; classic contributions identify task-based complementarities and no average negative wage effects on natives, especially in high-demand Northern regions (Gavosto et al., 1999; Venturini, 2002). More recent evidence shows complementarities mainly for high-educated Italians, while foreign residents and low-educated Italians are displaced in internal mobility (Basile et al., 2020; Mocetti and Porello, 2010). Migrant networks lower movement costs and channel flows into specific territorial/occupational niches: they ease entry but can lock trajectories into low-mobility paths (Casacchia et al., 2022).

Spatially, foreign immigration is skewed toward the North–Center and metropolitan areas, producing strong provincial heterogeneity; within cities, price/tenure constraints and network-mediated access generate clustering and micro-segregation; in several contexts segregation declines with duration, though patterns remain heterogeneous across cities and groups, and path dependence can anchor some communities in low-mobility niches (Benassi et al., 2022; Daconto and Montesano, 2024).

These territorial asymmetries are central for understanding the demographic mechanisms analyzed in Chapter 3, where international and internal migration are jointly assessed in shaping the convergence or divergence of aging across Italian municipalities. Immigration therefore does not simply add population; it redistributes the age structure across space, reinforcing or mitigating existing demographic divides.

Moreover, immigration is also closely connected to Italy's human-capital balance. Migrants bring skills that differ by origin, sectoral insertion, and stage of the life course, and these skills can complement or substitute those of natives. For Italy, the educational composition of immigrant inflows partly offsets the loss of young workers and graduates caused by emigration and internal mobility, though not uniformly across territories or qualification levels. Chapter 4 incorporates these inflows—together with departures and internal movements—into a unified stock-flow-consistent framework, showing how the net balance of human capital varies across regions. Immigration thus shapes not only demographic trends but also the distribution of capabilities within the country.

1.2 Theoretical framework supporting empirical studies

This section reviews the main theoretical approaches to migration, whose insights help interpret the patterns analyzed in the empirical chapters. Contemporary migration reflects the interaction of economic incentives and expectations, demographic asymmetries, institutional architectures, and network-mediated cost reductions. Theories summarized here provide a multilevel map that explains not only why people move, but also who moves, where, when, and for how long, given the evolving configuration of these determinants.

The earliest systematic accounts of migration are traced to Adam Smith (1776), who framed labor mobility as a natural corrective to wage differentials when institutional barriers are absent. This intuition already highlights core economic drivers, relative earnings and employment prospects, as the signals to which individuals respond under varying movement costs and regulatory constraints. Building on this, Ernest George Ravenstein (1885–89) offered the first empirical regularities from UK census data, identifying short-distance and stepwise movements, rural–urban shifts, and the predominance of economic motives. His inductive laws anticipate later evidence that bilateral flows respond systematically to destination income, income gaps, migration costs and legal/policy barriers (Mayda, 2010; Ortega and Peri, 2013).

Mid-twentieth-century work generalized these insights through the push–pull perspective (Lee, 1966), conceptualizing migration as the outcome of adverse conditions at origin (unemployment, low wages, land scarcity, insecurity) versus attractions at destination (higher earnings, services, networks), filtered by intervening obstacles (distance, information, policies), and individual selectivity. Here, drivers are explicitly multidimensional (economic, institutional and informational) and operate through heterogeneous decision thresholds rather than implying perfect adjustment.

This reconceptualization paved the way for neoclassical models. At the macro level, migration reallocates labor from low-wage regions with labor-surpluses to high-wage regions with labor shortages (Lewis, 1954; Harris and Todaro, 1970).

At the micro level, prospective movers compare expected lifetime returns with direct and opportunity costs and migrate if net benefits are positive (Sjaastad, 1962). These frameworks take into account observed drivers such as wage and productivity differentials, employment prospects, and the cost of information and mobility, while predicting selection on skills when credit constraints are limited.

From the 1980s, the New Economics of Labor Migration (NELM) reframed decisions at the household level in settings with incomplete credit and insurance markets. Migration becomes a risk-management and financing strategy: families allocate members across locations to diversify income streams, smooth consumption, and fund investments at origin via remittances (Stark and Bloom, 1985; Taylor 1999; Stark and Levhari, 1982). A second pillar is relative deprivation: incentives hinge on one's position in the local income distribution, not just absolute gaps (Stark and Taylor, 1989; 1991). These mechanisms explain why flows persist under modest average wage gaps and why temporary/target migration and return are common once savings or investment goals are met.

Offering a structural critique, Dual/Segmented Labor-Market Theory (Piore, 1979) shifts the focus to demand-side drivers in advanced economies. Chronic shortages in secondary segments, low pay, instability, limited mobility, and social stigma, create a persistent pull for migrant labor even without large wage gaps, making migration a demand-driven institutional feature rather than a transient adjustment. This view aligns with observed concentration of migrants in sectors with hard-to-fill vacancies and low native take-up.

Complementing this, World-systems Theory (Wallerstein, 1974; 1979; Portes and Walton, 1981) embeds mobility in core–periphery relations shaped by trade, investment, and historical ties within a capitalist world-economy. The penetration of capitalist relations into peripheral regions disrupts livelihoods and creates labor surpluses while generating demand in cores, hard-wiring structural drivers that sustain flows even when local labor markets appear to stabilize. Political science highlights that these dynamics are mediated by states: citizenship and border regimes, political coalitions, and institutional crises shape who moves, how, and under what status (Zolberg, 1981).

Moving beyond structure versus agency, Migration-network Theory (Massey et al., 1993; 1998) identifies social and informational drivers as informal institutions that lower search, financing, and settlement costs (housing, referrals, bureaucratic navigation), reduce uncertainty, and raise success probabilities. As networks expand, cumulative causation sets in declining expected costs and risk broaden access to liquidity and information, changing the selection of who migrates over time (McKenzie and Rapoport, 2010; Munshi, 2003). In the digital era, online platforms intensify these mechanisms by accelerating real-time information and reputation systems (Dekker and Engbersen, 2014).

Across theoretical perspectives, institutions are not merely frictions but first-order determinants. Visa regimes, quotas, bilateral agreements, rights at destination, welfare access, political cycles, and early-warning systems shape volumes, timing, composition, and duration of migration; tightening one channel can induce substitution toward other legal categories or irregular routes (Ortega and Peri, 2013).

Migration does not respond only to current rules but also to expectations about future ones. A growing body of research shows that migrants incorporate anticipatory behavior into their decisions: when institutions signal possible future constraints, individuals react *ex ante*, adjusting destinations before policies formally change. This expectations-based response is consistent with models in which uncertainty increases perceived migration costs and pushes individuals toward less risky alternatives. In such settings, institutional shock can generate not only level effects but also diversion effects, redirecting flows toward destinations perceived as more stable or predictable. Theories of policy-driven migration and channel substitution (Czaika & de Haas, 2013, 2017) suggest that when one route becomes uncertain, alternative routes expand, especially for groups more exposed to future restrictions. These mechanisms provide the conceptual foundation for the first empirical chapter (Chapter 2), which examines how the uncertainty created by the 2016 Brexit referendum reshaped destination choices of emigrants from Italy even before any legal change took effect.

Migration-transition theory (Zelinsky, 1971; Skeldon, 1997, 2012) situates mobility within broader demographic and development dynamics, emphasizing that migration is not only a response to economic incentives but also part of long-term structural change. Large youth cohorts, urbanization, rising education and sectoral shifts expand the pool of potential movers, while population aging in high-income regions creates shortages in both high-skill and labor-intensive occupations. These demographic asymmetries sustain mobility over time, even when short-run wage gaps fluctuate (Notestein, 1945; Bloom et al., 2003). Importantly, migration also redistributes age structures across space: internal migration tends to concentrate young adults in economically dynamic areas, reinforcing core–periphery patterns, while international inflows can partly offset demographic decline in smaller or less attractive municipalities. As a result, territories exposed to similar macro-demographic forces may nevertheless converge or diverge depending on the direction and selectivity of migration flows. This perspective provides the

conceptual foundation for Chapter 3, which investigates how internal and international mobility contribute to the spatial reorganization of aging in Italy.

The measurement of skilled migration requires theoretical attention to both selection mechanisms and the spatial distribution of human capital. Models of migrant self-selection (Borjas, 1987) highlight that migrants differ systematically from non-migrants depending on expected returns to skills, credit constraints, and institutional conditions. Empirical studies confirm that migration is often positively selected with respect to education and ability (McKenzie and Rapoport, 2010), implying that counting departures alone systematically misrepresents the true loss of human capital.

At the same time, theories of human-capital externalities (Moretti, 2004) emphasize that spatial allocation of skills matters for local productivity, innovation, and long-run development. This makes it essential to distinguish between international and internal redistribution. These insights reveal a gap between classic volume-based indicators of "brain drain" and the theoretical need for quality-adjusted, stock–flow consistent measures incorporating selection, internal mobility, and foreign inflows. Chapter 4 develops such a framework to quantify Italy's net human-capital balance across regions.

Finally, environmental factors influence mobility both through sudden disasters and through slow-onset processes. Most movements are internal and short-distance, but migration to other countries can occur when livelihoods are at risk. Environmental shocks influence migration indirectly, through loss of income (e.g., crop failure), health risks, damage to housing, or decline in local services. It has been shown that climate change can increase emigration from agriculture-dependent regions to urban areas or abroad when credit/liquidity is available; conversely, very poor households may become immobile ('trapped') when shocks deplete the resources needed to move (Black et al., 2011; Bohra-Mishra et al., 2014; Cattaneo and Peri, 2016; Missirian and Schlenker, 2017; McLeman, 2014). In contexts of conflict, repression, or environmental stress, institutional failure and elevated risk generate forced migration, with routes and statuses mediated by asylum procedures, temporary protection, and non-refoulement (Schmeidl 1997; Moore and Shellman, 2007; Black et al., 2011). Although environmental drivers are not directly examined in the empirical chapters, they highlight the need to interpret migration decisions within a broader ecological and socio-economic context.

1.3 Research gaps and thesis contributions

Despite the extensive literature on the drivers, mechanisms, and consequences of migration, less attention has been paid to migration as a redistributive mechanism, that is, as a process that actively reallocates population, age structures, and human capital across interconnected territories. While existing research has generated rich insights into why individuals move and what the aggregate consequences of migration are, it has more rarely examined how different types of shocks, demographic dynamics, and measurement frameworks shape the spatial redistribution of people and capabilities. My thesis addresses three related gaps that, taken together, contribute to a more integrated understanding of migration as a force reshaping territorial inequalities.

The first gap concerns how migrants respond to policy uncertainty, rather than to formal policy changes, and how such responses translate into redistributive effects across destinations. Institutional frameworks are widely recognized as key drivers of migration, yet most empirical studies focus on implemented reforms, border closures, or changes in legal rights. Much less attention has been devoted to anticipatory behavior: how individuals react to the expectation of future constraints, particularly in contexts where uncertainty is unevenly distributed across skill groups. As a result, we know relatively little about whether and how institutional shocks that do not immediately alter legal conditions, such as referenda or political signals, can redirect migration flows across alternative destinations. From a redistributive perspective, these diversion effects are highly relevant for policy, as they imply that sudden institutional changes in one country may reallocate migration pressures across other countries, with consequences for labor markets, skill composition, and integration systems elsewhere in the EU. Chapter 2 addresses this gap by analyzing the Brexit referendum as a natural experiment in policy uncertainty, showing how the perceived tightening of future conditions in the UK altered the destination choices of emigrants from Italy and reshaped the international allocation of migrants across European destinations.

The second gap relates to the role of migration in shaping spatial patterns of population aging. While demographic transition theory emphasizes the links between fertility decline, urbanization, and structural change, less is known about how internal and international migration jointly contribute to the reorganization of age structures within countries. Existing work has tended to focus on national-level trends or broad rural–urban differentials, often

overlooking how selective mobility across territories may reinforce or counteract spatial divergence in aging. This gap is particularly salient in countries like Italy, where demographic decline intersects with long-standing territorial inequalities. From a policy perspective, identifying whether migration slows down, accelerates, or redistributes demographic aging across local areas is crucial for planning welfare provision, health and long-term care services, and place-based development strategies. Chapter 3 contributes to this literature by quantifying the extent to which internal and international migration act as mechanisms of spatial redistribution of aging, accelerating or mitigating demographic decline across Italian municipalities beyond what would be implied by fertility and mortality alone.

The third gap concerns the measurement of human-capital redistribution through migration. Traditional accounts of "brain drain" rely on outflow-based indicators that abstract from return migration, foreign inflows, and internal mobility. This approach is at odds with theoretical models of self-selection and human-capital externalities, which imply that the impact of migration on the skill endowment of a territory depends on the interaction between multiple flows and on the characteristics of both sending and receiving populations. As a consequence, standard measures risk overstating losses in some areas while masking compensatory or offsetting processes in others. From a redistributive perspective, assessing the effects of migration on human capital requires moving beyond unilateral counts of departures toward quality-adjusted measures of net change. Chapter 4 addresses this gap by developing a stock–flow consistent framework that integrates international and internal migration and explicitly incorporates selection into the assessment of Italy's net human-capital balance, providing a more accurate picture of how skills are redistributed across space.

Although the topics differ, policy shocks, demographic structure, and human capital, the underlying logic is consistent: in each case, migration is examined as a mechanism of spatial redistribution, and the corresponding gap in the literature arises from a limitation in how this redistributive process is identified or measured. Specifically, existing work tends to lack causal identification when migration responds to institutional shocks, to overlook spatial decomposition when migration reshapes demographic structures, or to rely on volume-based indicators that ignore the quality and circulation of skills. Table 1.1 summarizes the positioning of the three papers in terms of the research gap that each addresses and the corresponding contribution in terms of methods and outputs.

Table 1.1 - Gaps and contributions at a glance

Theme	**Gap**	**Contribution and Core Methods / Outputs**
Policy uncertainty and migration	Limited causal evidence on how anticipated policy changes affect migration; unclear diversion of flows across destinations	Identifies the causal effect of policy uncertainty on destination choice using the Brexit referendum as a natural experiment; event-study and DiD designs; estimates effects on migration levels and skill composition; documents the redirection of flows to alternative destinations other than UK
Migration and spatial population aging	Underexplored role of internal and international migration in shaping spatial convergence or divergence in aging	Decomposes the contribution of migration to local aging dynamics using spatiotemporal demographic accounting; β- and σ-convergence framework; quantifies whether migration accelerates, slows down, or redistributes aging across municipalities; highlights spatial heterogeneity
Human capital redistribution	Volume-based "brain drain" measures ignore quality, selectivity, return migration, and skill circulation	Develops stock–flow–consistent, quality-adjusted indicators of human-capital change; integrates international and internal mobility; distinguishes net brain drain from brain circulation, accounting for the education of both natives and foreigners

My thesis addresses these limitations by aligning each research question with a methodological approach suited to uncovering the relevant redistributive mechanism. Quasi-experimental designs are used to identify how policy uncertainty diverts migration flows across destinations; spatiotemporal demographic accounting and convergence frameworks are employed to decompose how mobility contributes to the reorganization of age structures across local areas; and stock–flow–consistent, quality-adjusted indicators are developed to assess how different migration flows jointly redistribute human capital. Taken together, these approaches provide a coherent empirical framework to study how migration reallocates people and skills across space in response to institutional shocks, demographic pressures, and incomplete measurement practices.

1.4 From gaps to evidence: roadmap for the three papers

The Italian setting provides a particularly well-suited vantage point for this thesis. Italy is simultaneously a country of immigration, emigration, and internal mobility, making it an ideal laboratory to study migration as a process that redistributes population and human capital across space. This threefold migration experience constitutes the common horizon of the three studies. In addition, the availability of rich Istat micro-data on migration flows enables a precise and consistent empirical analysis across all chapters.

Against this background, the discussion of research gaps in the previous section serves as a guide for reading the three papers around three analytical pivots: (i) the response of migration flows to exogenous institutional shocks, illustrated by the Brexit referendum; (ii) the role of internal and international migration in reshaping the spatial geography of population aging; and (iii) the measurement of human-capital redistribution through a stock–flow–consistent framework that integrates return migration, internal mobility, and foreign inflows. The following sections present the objectives and methods of each paper in turn, showing how this common contextual framework informs their motivations, hypotheses, and the interpretation of empirical results.

1.4.1 Policy uncertainty and migration.

The first paper examines how migration reacts when rules and expectations shift abruptly. Focusing on the uncertainty triggered by the June 2016 Brexit referendum, *Brexit uncertainty and migration: evidence from Italy* studies emigration from Italy using an event-study / difference-in-differences design with pre-trend and placebo checks. Comparing EU to non-EU migrants as a counterfactual, the paper documents a diversion of flows away from the UK toward alternative destinations. The composition of movers matters: responses are stronger where exposure to new barriers (visas, credential recognition, and administrative friction) is plausibly higher. Robustness checks, including the treatment of potential return moves and alternative outcome specifications, support the interpretation that policy uncertainty, not macro conditions alone, redirects migration and does so unevenly across groups (by citizenship status and education). Substantively, the paper shows that policy shocks can reshape destination choice even without immediate legal changes, anticipating future selectivity.

Brexit uncertainty and migration: evidence from Italy (Chapter 2)

Research Questions. The paper investigates whether policy-generated uncertainty, rather than material shocks such as disasters or recessions, can influence destination choice in international migration. Specifically:

RQ1: *Does the 2016 Brexit referendum trigger a diversion of Italian-based emigrants away from the UK toward alternative destinations?* Instead of analyzing outflows *to* the UK, our paper reverses the perspective and asks whether flows *to other countries* increase as a redirection effect.

RQ2**:** *Is the diversion effect homogeneous across migrant groups?* The analysis separates Italians at birth, naturalized Italians, and other EU citizens, to test whether exposure to post-Brexit uncertainty varies by citizenship status.

RQ3: *Does educational attainment condition responsiveness to policy shocks?* Among Italian natives, the study asks whether low-, medium-, and high-educated individuals react differently, probing whether diversion reflects not only legal constraints but also perceived skill selectivity of future immigration rules.

Methods. We exploit the quasi-exogenous timing of the June 2016 Brexit referendum to identify a diversion away from the UK. The outcome is emigration from Italy to non-UK destinations. EU citizens (including Italians) are treated, non-EU citizens represent the control group. Our two-way fixed-effects difference-in-differences model includes year and destination x nationality fixed effects; identification comes from the interaction of a post-referendum indicator with treated status and captures differential post-referendum shifts in non-UK destinations. We exclude 2016 from estimation and assess parallel trends via an event-study with Wald tests on pre-treatment leads. Inference uses heteroskedasticity-robust, clustered-by-id standard errors. As robustness, we (i) exclude return migration; (ii) re-estimate using Pseudo-Poisson Maximum Likelihood (PPML) methods on a balanced panel including zero flows (with population as an offset term and nationality, destination, and year fixed effects). Finally, we control for destination-level GDP per capita, unemployment, and life expectancy to ensure results are not mechanically driven by unrelated shifts in destination attractiveness.

1.4.2 Migration and spatial population aging.

The second paper asks whether migration mitigates or amplifies territorial imbalances in aging. In *Spatial convergence in aging: the role of migration*, we use the Potential Support Ratio (PSR) as an indicator of aging and apply a beta convergence approach to verify whether places with younger demographic structures age more rapidly. Through a two-step decomposition, we first test which component, between the working age population and the old age population, drives the beta convergence; then we further decompose the working age component into cohort turnover, mortality, and migration, to assess which of these factors contributes most to

convergence. Finally, we verify which type of migration (internal and international) has the greatest impact on convergence.

Two results stand out. First, aging converges overall: municipalities move toward similarly older structures over time. Second, once spatial heterogeneity is controlled for, migration works against convergence: internal migration of Italians concentrates working-age cohorts in metropolitan and economically dynamic areas, leaving peripheral and "inner" municipalities to age faster. International migration provides at most limited, non-systematic cushioning and does not fully offset these internal dynamics. Methodologically, we isolate migration's role within a transparent accounting framework; substantively, we show that migration reshapes the geography of aging, with implications for place-based policies and service provision.

Spatial convergence in aging: the role of migration (Chapter 3)

Research Questions. Our paper addresses a central but under-examined demographic question: Can migration alter not only the level but also the *spatial distribution and speed* of population aging? More specifically:

RQ1: *Is Italy experiencing spatial Beta convergence in aging at the municipal level, and to what extent?* That is: *Do initially younger territories age faster than older ones?*

RQ2: *What is the relative contribution of migration, mortality and cohort turnover to observed changes in PSR?*

RQ3: *How do international and internal migration differently shape local demographic trajectories and what territorial imbalances do they generate?* Internal migration may concentrate working-age cohorts in metropolitan areas, while international migration may offset demographic decline in smaller municipalities. The paper asks which mechanism dominates.

Methods: The paper combines fine-grained longitudinal demographic accounting with convergence modeling, avoiding simplistic regressions on aggregate aging indicators. Using municipal panel data (2002–2023), we measure aging via the Potential Support Ratio (PSR), the ratio between working-age and elderly populations. We apply a two-step demographic decomposition: (i) changes in PSR are split into old-age vs working-age components; (ii) the working-age component is further decomposed into cohort turnover, mortality, and net migration (internal vs international). We then estimate β-convergence models, absolute e conditional, including time-varying coefficients and a space–time trend. This strategy isolates the contribution of each demographic mechanism while controlling unobserved spatial and temporal heterogeneity.

1.4.3 Human-capital redistribution.

Classic narratives portray Italy's "brain drain" as a one-way loss of young graduates, but most existing indicators overlook two crucial elements: returns and internal mobility. The paper

Measuring brain drain in Italy: net migration flows and the North–South divide develops an integrated framework that measures net human capital change, not just how many graduates leave, but how many return or arrive, and how this balance differs territorially. Building on Becker et al. (2004), we construct quality-adjusted indicators that combine per-worker selection (who migrates relative to who stays), flow scale, and aggregate impact, with separate metrics for graduates. Applied to Italians aged 25–34 between 2013 and 2022, the results show three key patterns. First, international emigration has become increasingly selective: since 2019, emigrants are on average more educated than both residents and returnees, signaling a shift from quantity-based loss to quality-based loss. Second, internal migration rebalances the picture, but asymmetrically. The North largely compensates for its international losses by attracting human capital from the South, resulting in an overall gain; the South, on the other hand, faces a double loss, both abroad and to the North. Third, foreign inflows now play a compensatory role: since 2019 (the first year for which data on the level of education of immigrant foreigners is available), once return migrants and foreigners are included, Italy as a whole records an aggregate gain, but still suffers a disadvantage per worker, because those who leave are more educated than those who arrive. In short, the brain drain exists, but its geography and magnitude depend on what (and whom) we count. The paper argues that policy should move from counting departures to shifting balance-retention, return, and recognition of foreign skills.

Measuring brain drain in Italy: net migration flows and the North–South divide (Chapter 4)

Research Questions: Rather than asking only whether Italy is losing graduates, the paper asks what kind of human capital it is losing and where losses are concentrated. Our research questions are:

RQ1: *How large is Italy's brain drain once returns of Italian citizens are incorporated?* Are international departures of high-skilled individuals compensated by reverse mobility?

RQ2: *Does internal movement of human capital act as a compensatory force or as a secondary channel of loss?* In particular, does the South-North internal migration of human capital compensate the international brain drain of the North? And, do both forms of loss (international and internal) accumulate in disadvantaged territories?

RQ3: *Do foreign graduates arriving in Italy offset skill losses, or do they differ so much in profile that substitution is limited?* This question tests whether Italy is closer to a brain drain, brain exchange, or brain circulation regime.

Methods. To answer these questions, the paper builds a stock–flow–consistent measurement system grounded in Human Capital Theory, aligning selection (per-worker skill) with scale

(flow volume). For Italians aged 25–34 (2013–2022), we compute relative human capital per worker of emigrants, returnees, internal movers, and stayers using years of education and graduate shares, mapped via a Mincerian schooling return $\beta \approx 0.035$. This yields three families of indicators:

ψ / γ → *per-worker relative human capital of migrants vs. residents*

η → *migration rate (flow scale)*

Ψ / Γ → *aggregate impact* as percentage loss/gain of total or graduate human capital stock.

International, internal (South to North), and foreign inflows are considered separately, to isolate net effects at national and subnational levels. We use data on Population Registers (flows) and Labor Force Survey / Permanent Census (stocks), harmonized across educational levels.

1.5 Conclusion

This chapter argues that migration cannot be understood through a single interpretative lens, but that the diverse theoretical traditions in the literature converge on a common insight: migration operates as a mechanism of redistribution. Across classical economic theories, the New Economics of Labor Migration, macro-structural approaches, and network perspectives, migration emerges as a process through which population and human capital are reallocated across space in response to incentives, constraints, and uncertainty. Individual decisions are embedded in broader structures, yet they also contribute cumulatively to reshaping demographic, economic, and institutional contexts.

Within this framework, the Italian case offers a particularly revealing setting. Italy simultaneously experiences immigration, emigration, and internal mobility, with persistent South–Center-North flows, metropolitan concentration, and sectoral segmentation of labor markets. This threefold mobility makes it possible to observe redistribution processes at multiple spatial scales: across countries, across regions and municipalities, and across population groups. The availability of detailed Istat micro-data further allows these redistributive dynamics to be measured consistently across space and over time.

The research questions developed in the remainder of the thesis are directly derived from this redistributive perspective. The first concerns institutional uncertainty and asks how migration reallocates across destinations in response to exogenous political shocks, even before formal

policy changes take place. The Brexit referendum provides an ideal setting to identify these diversion effects and to measure how uncertainty reshapes the international distribution of migrants (Chapter 2). The second question focuses on demographic structure and examines how internal and international migration redistribute population aging across territories, potentially mitigating or reinforcing spatial divergence in a context of uneven demographic decline (Chapter 3). The third question addresses human capital and asks how skills are redistributed through migration once multiple flows, selectivity, returns, and foreign inflows are taken into account, moving beyond volume-based notions of brain drain (Chapter 4).

Seen together, the three empirical studies do not test a single theory but provide complementary evidence on how migration acts as a redistributive mechanism under different conditions and along different dimensions. Policy uncertainty reallocates migrants across destinations; mobility reshapes the geography of aging; and the interaction of multiple flows redistributes human capital across territories. By making these mechanisms observable and measurable, the thesis contributes to both migration theory and policy debates. It shows how institutional signals can redirect migration pressures, where migration is unlikely to offset demographic decline, and how more accurate measurement can inform retention, return, and attraction policies. By framing migration as a redistributive process, the thesis links demographic evidence to concrete policy choices, and it is in this dialogue that I found the coherence of my thesis.

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Chapter 2. Brexit uncertainty and migration: evidence from Italy

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Abstract

A substantial body of research has examined the impact of the June 2016 Brexit referendum from a UK-centred perspective. Much of this literature has focused on economic and social outcomes, with particular attention to migration. In this paper, we evaluate the causal impact of the uncertainty generated by the referendum on migration from the standpoint of a major country of origin - Italy, one of the principal sources of intra-EU flows to the UK. Specifically, we investigate whether the referendum redirected emigration flows from Italy towards alternative destinations (the *migration diversion* hypothesis). Drawing on detailed Italian administrative migration data, we also explore whether uncertainty induced by the referendum differentially affected distinct groups of migrants: Italians by birth, who acquired citizenship, and other EU citizens residing in Italy. Finally, we assess whether the effect of Brexit varies by educational attainment among Italian-born emigrants—high, medium, and low skilled. To address these questions, we implement a difference-in-differences strategy in which EU citizens emigrating from Italy serve as the treatment group, while non-EU citizens emigrating from Italy provide the control group. The findings offer clear evidence of migration diversion, particularly among low-skilled Italians by birth.

Keywords: Uncertainty, migration diversion, migration policy, Brexit, Italy, European Union
JEL codes: F22, J48, J61

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2.1 Introduction

From the Brexit referendum in June 2016 to the end of negotiations in January 2020, the United Kingdom (UK) experienced a prolonged period of uncertainty that affected both long-established migrant communities and newly arrived migrants (Benson et al. 2022a). In the immediate aftermath of the referendum, the UK's future migration policy remained undefined (Ntampoudi 2017; Owen 2017), and only at the conclusion of the negotiations was it confirmed that a points-based immigration system would take effect in January 2021 (Sumption 2022). While it is still too early to fully assess the implications of this new migration regime, the Brexit referendum offers a unique opportunity to investigate how policy uncertainty shapes migration behavior.

This study examines the causal impact of the uncertainty generated by the Brexit referendum on migration outflows from Italy over the period 2012-2019. First, we test whether this uncertainty reduced the attractiveness of the UK and redirected flows toward alternative destinations (the "migration diversion" hypothesis). Second, we assess whether the effects of Brexit-related uncertainty vary across different groups of citizens: Italians at birth, Italians who acquired citizenship (distinguished between those born abroad and those born in Italy), and other EU citizens. Finally, we analyze whether the Brexit referendum differentially affected Italian-born emigrants with high, medium, and low education levels.

A growing body of literature has explored the relationship between migration and uncertainty, recognizing that uncertainty is intrinsic to migration decision-making (e.g., Hall et al. 2022; Williams and Balaz 2012). Only a few studies examined the migration effects of Brexit-induced uncertainty, primarily using Eurostat/OECD data (Di Iasio and Wahba 2023; Auer and Tetlow 2023; Hall et al. 2022). These studies analyze the consequences of Brexit from the country of destination perspective, the UK, a country that has significantly shaped intra-European Union (EU) mobility (Castro-Martín and Cortina 2015) and has long been a major destination for EU citizens (Mooyaart and de Valk 2020). Their main findings include: (i) an increase in emigration from the UK to other EU countries; (ii) a decline in inflows of EU citizens into the UK; and (iii) an increase in outflows of EU citizens from the UK. However, Di Iasio and Wahba (2023) find no evidence of migration diversion.

Much less is known about the effect of the Brexit referendum on the migratory behavior of citizens from individual EU countries of origin, either those already residing in the UK or

potential new emigrants. This gap motivates studies that examine the effect of referendum-induced uncertainty from the perspective of a country of origin. The case of Italy is particularly relevant, as this country has traditionally supplied the UK with a substantial share of skilled labor. Italy is consistently among the leading countries of origin for migration to the UK (ONS 2021) and, since 2015, the UK has become the top destination for Italian emigrants, followed by Germany, France and Switzerland (Istat 2019).

Italian population register data offer rich individual-level longitudinal information on migrants' origins, destinations, and characteristics—such as age, educational attainment, and citizenship status, distinguishing Italians at birth from naturalized Italians (born abroad or in Italy). This distinction is important because the migration behavior of naturalized Italians differs from that of Italians at birth (Strozza et al. 2021; Bonifazi et al. 2021). These data also allow us to examine the impact of Brexit across different levels of education. [5] The strong educational selectivity of Italy–UK migration highlights the relevance of analyzing skill composition. Although the effects on overall migration intensity may be modest, the educational profile of migrants can vary substantially. Moreover, the skill-selective immigration policy implemented in January 2021 reinforces the importance of studying migrants' educational levels, as the reform aimed to increase the share of highly educated and professionally qualified migrants (Sumption & Fernández-Reino 2018; Sumption 2022).

In this paper, we analyze Italian emigration rates using a difference-in-differences framework in which Italians and other EU citizens emigrating from Italy constitute the treatment group (the only groups affected by the Brexit referendum and the ensuing uncertainty regarding immigration policy and migrant rights under the end of free movement), while non-EU migrants serve as the control group. Our findings provide the first evidence, from a country-of-origin perspective, of how migration-policy uncertainty can influence emigration intensity and shape the choices of migrants with different characteristics.

The remainder of the paper is structured as follows. Section 2.2 reviews the literature on the migration effects of the Brexit referendum and outlines our hypotheses. Section 2.3 presents descriptive evidence on Italian emigration over the study period. Section 2.4 describes the

[5] There is a consensus in using the information on educational attainment to measure migrants' skills or competencies, as employers generally use formal education as a 'signal' for labor skills to reduce asymmetric information problems (Spence 1978).

empirical strategy. Section 2.5 reports the econometric results. Section 2.6 concludes and discusses the implications.

2.2 Background and research questions

2.2.1 From the freedom of movement to Brexit

Over 33 million British citizens voted in the Brexit referendum, with the Leave campaign winning 51.9% of the vote against 48.1% for Remain. The results revealed a marked polarization: support for Leave was particularly strong among British citizens aged 65 and over (64%) and those with low to medium levels of education (70%), whereas support for Remain was concentrated among young people aged 18 to 24 (71%) and university graduates (68%), predominantly living in large cities[6].

Between the referendum vote in June 2016 and the UK's withdrawal from the EU in January 2020—followed by a transition period, formally ending on 31 December 2020, during which the UK remained bound by EU rules[7] —there were four years of intense debate over what the new migration policy should be and what would replace free movement (Portes 2016, 2018, 2019, 2021, 2022a, 2022b). During this period, EU citizens faced significant uncertainty regarding future migration policies and their rights to reside and work in the UK. On the one hand, this uncertainty may have discouraged potential new EU migrants, especially low-skilled workers—from choosing the UK as a destination, prompting them to prefer alternative destinations due to the difficulty of planning for themselves and their families (Di Iasio and Wahba 2023). On the other hand, the same uncertainty may have encouraged some EU citizens to migrate to the UK before any policy changes took effect (Auer and Tetlow 2023). Therefore, the overall impact of the Brexit referendum on migration flows is theoretically ambiguous and must be assessed empirically.

In January 2021, free movement for EU citizens came to an end, and the UK government introduced an employer-driven points-based work permit system that applies equally to EU and non-EU migrants. Under this system, work visas are granted only to medium- and high-

[6] See the following: https://www.electoralcommission.org.uk/who-we-are-and-what-we-do/elections-and-referendums/past-elections-and-referendums/eu-referendum/results-and-turnout-eu-referendum

[7] Worker migration between the UK and other EU countries was not restricted until the entry into force of the points-based immigration system in January 2021 following Brexit.

skilled workers deemed able to fill shortages in the UK labor market, with applicants assessed on the basis of their skills. Low-skilled workers are generally ineligible for work visas, except through a seasonal agricultural workers programme. Even among higher-skilled occupations, restrictions apply when employers do not sponsor the application.

Although it is still too early to evaluate the long-term effects of this new immigration regime, an important question concerns the impact of the referendum outcome on the migration behavior of EU citizens before January 1st, 2021, when the UK formally exited the EU framework.

It should also be noted that many EU citizens living in the UK may not have registered with local population authorities, potentially leading to an undercount of the true number of migrants residing in the country (Rampazzo et al. 2021). Yet, at the end of the transition period (January 1st, 2021), eligibility for the new immigration system required migrants to hold settled or pre-settled status to remain in the UK after Brexit. As the direction of post-Brexit migration policy, especially its restrictions on low-skilled workers, became increasingly clear, many previously unregistered migrants may have rushed to formalize their residence status to avoid adverse consequences. This consideration applies equally to Italian emigrants who had been living permanently in the UK before Brexit.

2.2.2 Previous studies

Since the announcement of the Brexit referendum in 2015, the implications of a potential UK withdrawal from the EU have become a critical topic for scholars not only in economics and political science but also in sociology and demography (Breinlich et al. 2016; Tilford 2015). Migration, in particular, has been widely debated by researchers (e.g., Barrett et al. 2015) and by political actors who amplified anti-immigration rhetoric in the public discourse (Cap 2017). A widespread perception of uncontrolled migration played a significant role in shaping public opinion during the referendum campaign and strongly influenced the final outcome (Ford and Goodwin 2017; Botterill et al. 2019; Evans and Mellon 2019).

Since the referendum result, a vast literature has examined the consequences of Brexit for the UK (e.g., Treasury 2018). Brexit has been argued to reshape public opinion, political behavior, and party competition, and to contribute to long-term social change (Ford and Goodwin 2017). Many studies have focused on economic implications (Armour 2017; Graziano et al. 2021;

McGrattan and Waddle 2020), including the effects on trade (e.g., Berthou et al. 2020; Gutiérrez et al. 2021), while others have analyzed the likely impact of the new migration regime (Campos and Timini 2019; Berthou et al. 2020; Benson et al. 2022a). One of the central issues in the debate concerned the range of feasible Brexit scenarios, from a "hard" Brexit to a "soft" one (Wallace 2016; Currie 2016). The degree of restrictiveness of the post-Brexit migration framework ultimately depended on how the UK chose to implement Brexit and on the content of future trade and financial agreements with the EU. This context generated substantial economic and political uncertainty, affecting both EU migrants already living in the UK and potential future migrants, as well as the future governance of migration flows between the UK and the EU (D'Angelo and Kofman 2017).

Uncertainty is a well-known determinant of migration decisions at the individual level (O'Connell 1997; Williams and Baláž 2012), but it also shapes migration at the macro level (Moretto and Vergalli 2012; Donadelli et al. 2018). This relationship has been investigated from multiple perspectives, as reviewed by Hall et al. (2022). Uncertainty is regarded both as a defining feature of migration trends and as a major challenge for future mobility (Barker and Bijak 2021). Fraser and Üngör (2019) showed that migration is closely linked to economic uncertainty, while Donadelli et al. (2018) emphasized the importance of personal risks and uncertainties.

Some scholars predicted a decline in migration flows following the end of free movement (Vargas-Silva 2016; Forte and Portes 2017a, 2017b; Campos and Timini 2019), whereas others analyzed migration dynamics after the referendum (Portes 2021). Using regression-based approaches, several studies forecast a significant negative impact of Brexit on trade and migration flows between the EU and the UK, as well as broader macroeconomic effects through these channels (Berthou et al. 2020; Campos and Timini 2019; Portes 2022a). Di Iasio and Wahba (2023) examined the impact of the 2016 referendum and the expected Brexit on migration flows and net immigration to the UK over 2016–2019, employing a difference-in-differences strategy comparing EU and non-EU migration before and after the vote.

A large body of work has also explored the impact of Brexit on specific migrant communities in the UK (Benson et al. 2022a). After the referendum, many migrants reassessed their sense of belonging (Botterill et al. 2019). Most studies have focused on either the UK alone or on bilateral UK–EU/EEA or UK–non-EU/EEA relationships (Benson et al. 2022a). Other contributions

have analyzed how migrants already residing in the UK adjusted their plans (Jancewicz et al. 2020). Research has also examined British nationals living elsewhere in the EU, documenting their concerns and their efforts to secure their rights in the aftermath of Brexit (Auer and Tetlow 2023; Benson et al. 2022b; Hall et al. 2022). Using Eurostat aggregate annual immigration data by nationality for 2008–2019, Auer and Tetlow (2023) show that the Brexit referendum led to a disproportionate increase in immigration of British nationals to other EU countries compared to movements of non-British EU/EFTA nationals to EU countries over the same period.

A related strand of research emphasizes that migration responses to policy changes and uncertainty can be heterogeneous by skill and education. Because migration costs, credit constraints, and expected returns differ across education groups, shocks affecting expected access to labor markets or migrant rights may generate skill-selective adjustments in both the volume and the destination of migration. In the Brexit context, the prospective shift toward a more selective immigration regime and the increasing salience of legal status may have affected low-educated migrants (who are more exposed to employment insecurity and eligibility constraints) more strongly than highly educated migrants (Sumption and Fernández-Reino, 2018; Sumption, 2022). This motivates our focus on education-specific diversion effects among Italian-born migrants.

2.2.3 Hypotheses

Based on the existing literature, we hypothesize that the instability generated by the absence of a clearly defined migration policy during the 2016–2019 period may have redirected EU citizens' migration flows from Italy toward alternative destinations (migration diversion hypothesis, H1). Following Di Iasio and Wahba (2023), we apply a difference-in-differences approach to test these hypotheses, classifying all EU citizens migrating from Italy as the treatment group, while non-EU citizens constitute the control group (see Section 2.4).

Unlike previous studies, however, we do not treat all EU citizens as a homogeneous group. Emigration behavior varies considerably across different categories of EU citizens. First, we distinguish between Italian citizens and other EU nationals living in Italy who emigrate during the observation period. The latter have already migrated once and are generally more likely to migrate again than Italians (Migali and Scipioni 2018; Benassi et al. 2019; OECD 2008). Consequently, the political uncertainty triggered by the Brexit referendum may have influenced

their migration decisions differently. Moreover, some EU nationals in Italy may simply return to their country of origin due to the natural completion of their migration project or for other reasons. Therefore, we hypothesize that Italian citizens were more affected by Brexit-related uncertainty and therefore redirected their destination choices to a greater extent than other EU citizens (H2).

Furthermore, among Italians, we distinguish between "Italians by birth" ("natives") and those who acquired Italian citizenship. The emigration behavior of "naturalized citizens" may differ depending on whether they were born abroad or in Italy. Those born abroad may find relocation easier due to their prior migration experience (Strozza et al. 2021; Istat 2022), and their socioeconomic characteristics often resemble those of low-educated natives. By contrast, naturalized individuals born in Italy may behave more similarly to Italian natives. Overall, we expect naturalized natives to be less affected by uncertainty over future migration policies (H3).

Finally, for Italians by birth, those for whom we have reliable information on education, we distinguish between low-, medium-, and highly educated migrants (i.e., those with primary, secondary, and tertiary education, respectively). As noted earlier, the UK's immigration system has been structured to favor the entry of high-skilled over low-skilled workers. Under conditions of uncertainty, this may have led low-skilled individuals to adjust their migration plans differently from high-skilled ones. High-skilled individuals may have perceived themselves as likely to remain welcome in the UK even after Brexit, much like highly skilled migrants from non-EU countries. Therefore, we hypothesize that the impact of Brexit-related uncertainty on the choice to migrate to destinations other than the UK (i.e., migration diversion) was stronger for low-skilled than for high-skilled workers (H4).

By empirically testing these hypotheses, we aim to contribute to a deeper understanding of the consequences of Brexit on migration flows from a country-of-origin perspective.

2.3 Italian emigration: some stylized facts

Italy has a long history of emigration and a comparatively recent experience of immigration. Like other Southern European countries, Italy underwent a renewed phase of emigration after the Second World War, accompanied by limited foreign immigration (King 2000; Peixoto et al. 2012). The establishment of the European Economic Community (EEC) in 1957 stimulated intra-European mobility. Between 1946 and 1975, statistical sources estimate that around 5

million Italians emigrated to other European countries, resulting in a net migration loss of approximately 1.5 million people (King 1985). The energy crisis of the 1970s and the subsequent anti-immigration policies adopted by host countries sharply reduced emigration flows and triggered a period of return migration (Bonifazi et al. 2009).

During this time, Italy also gradually became a country of immigration. Thanks to sustained inflows of immigrants—initially from North Africa, then from the Balkans, and more recently from the Middle East—the migration balance with foreign countries has been positive since 1973. Nevertheless, the emigration of Italian citizens has continued, giving rise to a new form of mobility.

Another major turning point was the creation of the European Union under the Maastricht Treaty in 1993. Free movement rights significantly reshaped mobility within Europe, enabling millions of EU citizens to relocate and reside across member states. The UK played a central role in this process, becoming one of the main destinations for EU migrants. Italy is among the leading countries of origin in these flows and, since 2015, the UK has become the primary destination for emigration from Italy (Istat 2017).

According to official statistics, more than 809,000 Italians emigrated during the period 2012–2019, with a clear upward trend: around 68,000 departures in 2012 compared to more than 122,000 in 2019 (+79%) (Table 2.1). What characterizes this new emigration wave, however, is not so much the scale, substantially lower than in the past, but rather the changing profile of those who leave. The heterogeneity of contemporary Italian emigrants can be observed in terms of skills (high-skilled versus low-skilled) and citizenship status (Italian at birth versus foreigners and naturalized citizens).

Table 2.1 - Emigrations from Italy in the years from 2012 to 2019

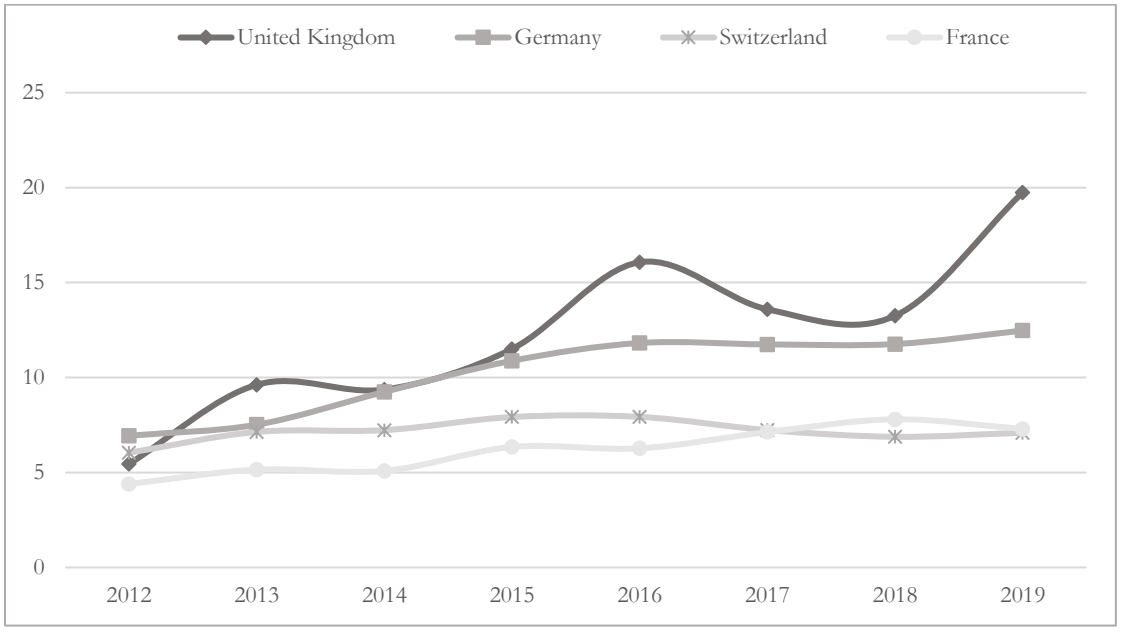
Years	Total	Italians	of which: Italians	% of Naturalized on
2012	106,216	67,998	3,314	3.1
2013	125,735	82,095	5,540	4.4
2014	136,328	88,859	8,457	6.2
2015	146,955	102,259	13,696	9.3
2016	157,065	114,512	19,837	12.6
2017	155,110	114,559	23,336	15.0
2018	156,960	116,732	27,274	17.4
2019	179,505	122,020	26,326	14.7

Source: Our elaborations on Istat data.

Work, housing, and family-related reasons are the most common drivers of mobility across all age groups. Most moves occur during working age, a period of life-course transitions such as labor market entry, higher education, marriage, or parenthood. Individuals aged 25–64 account for most emigrants (around 68%) and exhibit the highest migration rates. Italian emigrants in this age group predominantly move to European countries, with one in three choosing the UK or Germany as their preferred destination (Figure 2.1).

The flows of adult Italian citizens moving to the UK have grown steadily, contributing to the already substantial stock of Italians residing in England and Wales (around 439,000 in January 2022 according to AIRE data). This stock has doubled over the past decade and increased by 40% compared to 2016, the year of the Brexit referendum.

Figure 2.1 - Italian emigrants (aged 25-64) to main EU countries of destination (thousand). Years: 2012-2019

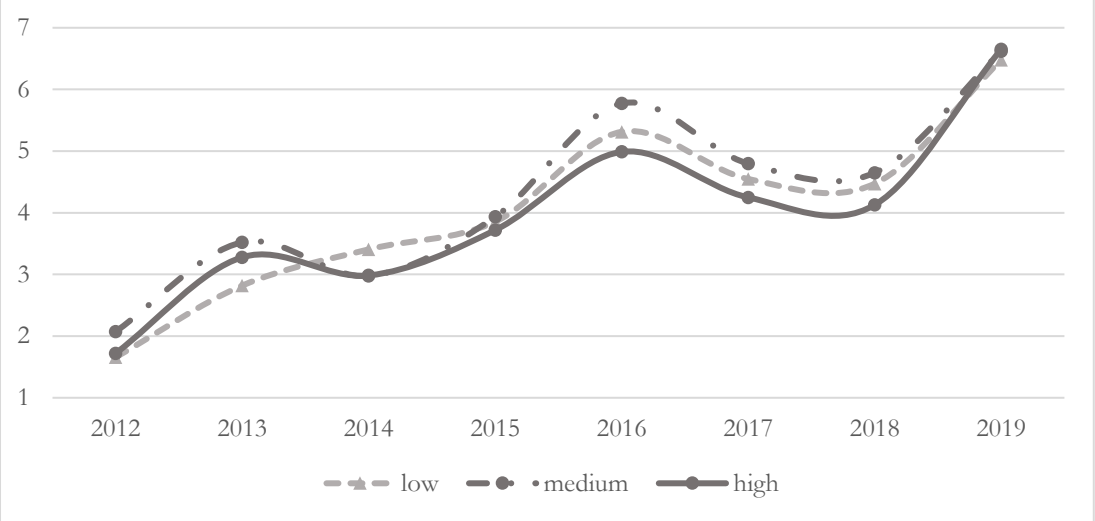


Source: Our elaborations on Istat data.

In the early 2000s, the Italian presence in the UK was mostly composed of well-educated middle-class young adults (Conti 2012). Over the following decade, however, the profile of migrants changed. The traditionally high-skilled component was increasingly accompanied by flows of young, less-skilled workers, often excluded from stable opportunities in the Italian labor market (D'Onofrio and Marino 2017). During our sample period, migration outflows were characterized by a larger share of individuals with an educational level equal to or lower than

upper secondary education (Figure 2.2). A key determinant of these outflows has been the strong UK demand for foreign labor in sectors marked by high turnover, low qualification requirements, low wages, and flexible working arrangements (the so-called "social dumping"). Since the mid-2000s, this demand has been met increasingly through intra-EU migration rather than extra-EU inflows. Employer preferences for specific nationalities deemed suitable for certain roles also played a role (MacKenzie and Forde 2009). These dynamics help explain the migration of low-educated Italians into sectors such as catering, as well as the mobility of medium- and high-educated youth. This shift in the educational composition of Italy–UK migration is central to our analysis. Because Brexit-related uncertainty and the expected tightening of access conditions are likely to be more salient for migrants with weaker labor-market positions, we explicitly test for heterogeneous diversion effects by education (H4).

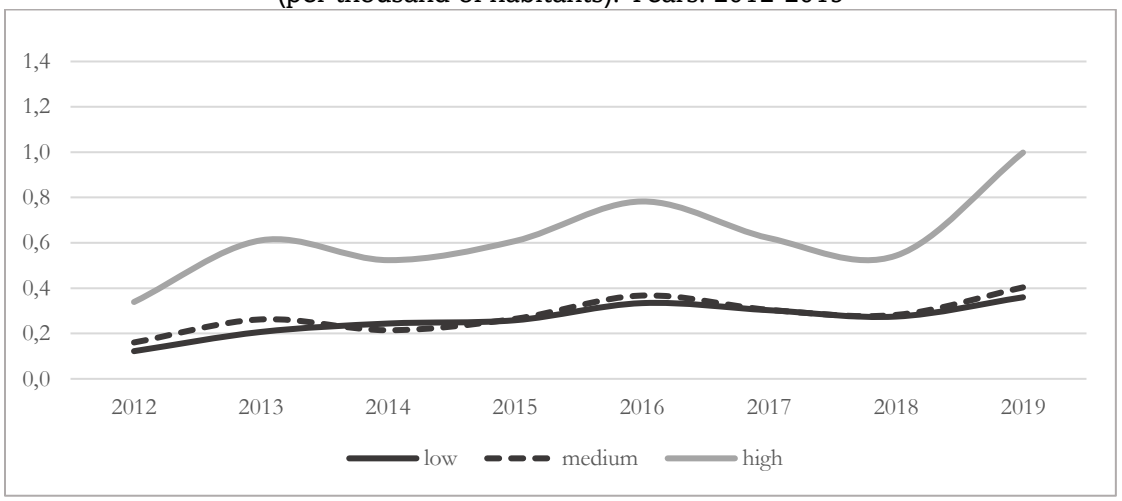
Figure 2.2 - Emigration flows of Italians at birth (aged 25-64) to the UK by education level (thousands). Years: 2012-2019



Source: Our elaborations on Istat data.

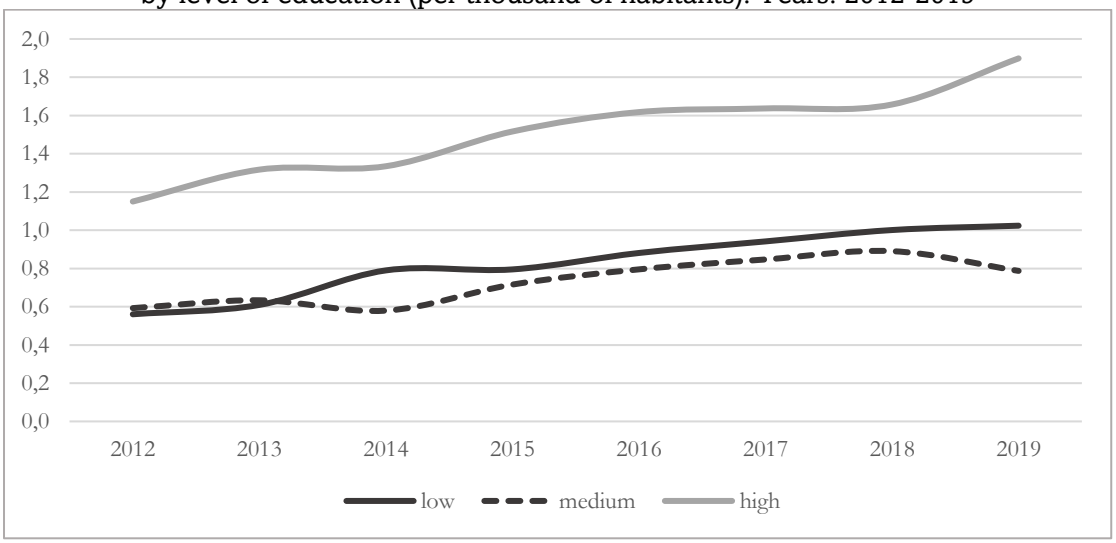
Finally, it is worth noting that the migration propensity of Italians at birth to the UK, disaggregated by education level, exhibits more variability over time than the propensity to migrate to other EU countries, which follows an almost linear growth pattern. This distinct trend may be associated with the uncertainty created by Brexit, an issue analyzed in the next section. In both cases, the emigration propensity of highly skilled individuals is, on average, twice as high as that of low- and medium-skilled individuals (Figures 2.3 and 2.4).

Figure 2.3 - Emigration rates of Italians at birth (age 25-64) to the UK by level of education (per thousand of habitants). Years: 2012-2019



Source: Our elaborations on Istat data.

Figure 2.4 - Emigration rates of Italians at birth (age 25-64) to other countries (except the UK) by level of education (per thousand of habitants). Years: 2012-2019



Source: Our elaborations on Istat data.

2.4 Data and methodology

This section first describes the data source and sample construction, and then presents the empirical strategy used to identify the causal impact of the Brexit referendum.

To evaluate the effect of the Brexit referendum on migratory flows from Italy, we adopt a difference-in-differences (DD) strategy. In the first stage of the analysis, all EU citizens migrating from Italy to foreign countries (excluding the UK) constitute the treatment group,

while all non-EU citizens emigrating to the same destinations serve as the control group.

The analysis relies on data on changes of residence recorded in the Municipal Population Registers[8]. The Italian National Institute of Statistics (ISTAT) collects these data at the municipal level. The microdata include individual information on age, educational attainment, and citizenship, as well as origin and destination country. Crucially, they allow us to distinguish between Italians at birth and Italians who have acquired citizenship. These data also ensure consistency between migration flows and the resident population by citizenship.

The observation period covers the years 2012–2019. We exclude 2020, although it is the year of the UK's actual exit from the EU, because mobility-restriction measures adopted globally in response to the COVID-19 pandemic affected countries unevenly (e.g., due to different border control measures). A counterfactual approach would not fully account for these heterogeneous shocks. During our sample period, no major changes occurred in UK immigration policy toward EU or non-EU citizens.

We compute outward migration flows of individuals aged 25–64 of nationality *i* (per thousand inhabitants) moving from Italy to destination area *d* [9]in year *t*. For Italian citizens, emigration rates are computed using the resident Italian population aged 25–64 as the population at risk; for foreign citizens, the denominator is the foreign resident population in the same age group. The country of origin is always Italy.

We consider 19 nationality groups[10] (excluding British emigrants). Italian citizens are split into Italians at birth and naturalized Italians; the latter are further divided into those born in Italy and those born abroad, while Italians at birth are classified by educational attainment (low, medium, and high). Each foreign nationality group is additionally separated into (i) those returning to their country of origin and (ii) those moving to another foreign destination. As a result, for each year *t*, we observe 304 dyadic observations (*i–d* pairs), representing migration flows from 19 citizenship groups to 16 destination areas.

[8] Official data on change of residence may suffer from some limitations due to the administrative data registration process, which may not accurately capture de facto migration changes. Registration or de-registration from the population registers due to migration is a formal act that may take place after an actual move to/from a foreign country and may underestimate the outflow of foreigners who leave the country without reporting their departure. Generally, this statistical bias is not relevant and is homogeneously distributed across citizens and destinations.

[9] See Table A2.1 in Annex 2

[10] See Table A2.2 in Annex 2

We now illustrate the empirical strategy used to identify the causal impact of Brexit on migration diversion. As noted above, the outcome variable is the emigration rate (per thousand inhabitants) of Italian and foreign citizens from Italy to destinations other than the UK. A simple before-and-after comparison of EU emigrants (the treated group) would not yield causal conclusions, as time-varying confounders may also influence migration. The DD approach addresses this by comparing before-and-after changes in outcomes between the treatment and control groups. The causal effect of the referendum is thus given by the difference in the post-treatment outcome gap between groups minus the difference in the pre-treatment outcome gap. This removes common time-varying factors.

The validity of the DD design depends on the parallel-trend assumption—that the treated and control groups would have followed similar trends in the absence of the treatment (Angrist and Pischke 2008). This assumption can be assessed by examining pre-treatment outcome trends for both groups. Parallel pre-treatment dynamics suggest that the groups would likely have continued to evolve similarly in the absence of treatment.

In a multi-period setting, the DD estimator is implemented via a two-way fixed-effects (TWFE) model:

$$y_{idt} = \alpha_{id} + \gamma_t + \tau D_{it} + \sum_k^K x_{k,dt}\,\beta_k + \varepsilon_{idt} \qquad (1)$$

where y_{idt} is the outcome, *i* indexes nationality, *d* destination area, and *t* year (excluding 2016). The treatment dummy (D_{it}) equals 1 for EU nationality (Italians at birth, naturalized Italians, and other EU citizens) in post-referendum years ($t > 2016$). Its coefficient (τ) captures the average treatment effect on the treated (ATT; Goodman-Bacon 2018). The vector $\sum_k x_{k,dt}$ includes destination-specific covariates: log GDP per capita, unemployment rate, and log of life expectancy at birth. The terms α_{id} are nationality-by-destination fixed effects; γ_t are year fixed effects, and ε_{idt} an idiosyncratic error assumed to be identically and independently distributed.

To provide a test of the parallel-trend assumption inherent in equation (1), we also adapt equation (1) into the following event-study specification:

$$y_{idt} = \alpha_{id} + \gamma_t + \sum_{e=-L}^{-1} \delta_e\, D_{it}^e + \sum_{e=0}^{M} \theta_e\, D_{it}^e + \sum_{k=1}^{K} x_{k,dt}\,\beta_k + \upsilon_{idt} \qquad (2)$$

where $e = 0$ denotes the treatment year. As in standard event, leads (M) are binary variables

representing periods *after* the event, used to estimate the effect of the event on outcomes in the periods following it; lags (L) are binary variables representing periods *before* the event, used to estimate the effect of the event in the periods leading up to it, often used to check for pre-trends. The event itself is normalized to time zero, and the leads and lags capture the estimated effects relative to this baseline period. For example, a "+1 lead" indicates the first period after the event and a "-1 lag" indicates the first period before the event. The effects of a series of lags and leads can indicate if there was an anticipatory effect or a persistent long-term effect. Therefore, δ_e are the pre-event coefficients, which can also be used as a diagnostic tool to assess the parallel trend assumption, while the θ_e coefficients measure the effect of participating in the treatment at different lengths of exposure to the treatment. We provide a Wald test for the null hypothesis of a joint lack of significance of the δ_e coefficients.

So far we have assumed that all EU citizens form a homogeneous treatment group. As discussed in Section 2, we relax this assumption and allow migration responses to differ across groups. Accordingly, we estimate equations (1) and (2) within three separate specifications. Model 1 treats all EU citizens migrating from Italy to countries other than the UK as the treated group. Model 2 distinguishes between Italians and other EU citizens. Model 3 focuses exclusively on Italians and further disaggregates the treated group into naturalized citizens (born in Italy or abroad) and Italians at birth differentiated by education (low, medium, and high). All heterogeneous treatment effects are estimated relative to the control group, which is the omitted category.

The final estimation sample varies across specifications. Firstly, because the analysis is conducted on an unbalanced panel, because dyadic nationality–destination cells with zero migration flows are excluded from the baseline TWFE estimations. Secondly, because sample size varies across models because of the progressive disaggregation of the treatment group. While Model 1 includes all EU citizens, Model 2 distinguishes Italians from other EU citizens, and Model 3 further restricts the sample to Italian citizens only, disaggregated by citizenship status and education level. These restrictions mechanically reduce the number of cross-sectional units and observations available for estimation.

2.5 Estimation results

2.5.1 Main evidence

This section presents the results of the counterfactual analysis evaluating the impact of the 2016 Brexit Referendum on migration (Tables 2.2–2.3). The outcome variable is the emigration rate (from Italy to other countries, excluding the UK). As explained above, we consider 304 potential citizenship–destination (id) combinations over seven years. However, emigration flows are zero for some id–year pairs, which we exclude from the analysis. As a result, the panel is unbalanced: the number of cross-sectional units (id) is 208, the number of years per unit ranges from 2 to 7, and the total number of observations is 1,413. Section 2.5 reports a robustness check based on pseudo-Poisson regression methods applied to a balanced panel that includes zero flows.

We begin by estimating Equation (1), using as the treatment group all EU citizens migrating from Italy to foreign countries other than the UK (see Table 2.2 column "Model 1"). For this group, the TWFE regression results support the hypothesis that policy uncertainty triggered by Brexit generated migration diversion. The coefficient of the difference-in-differences estimator, τ, associated with the dummy D_{it}, is positive and statistically significant. Inference is based on covariance-matrix estimators robust to heteroskedasticity across groups, following the White method for panel models (Arellano 1987). Observations are also clustered by (*id*) "group" to account for within-group serial correlation.

The coefficient should be interpreted as a change in the emigration rate: for instance, a value of 0.014 implies that, due to the EU Referendum, the emigration rate of EU citizens from Italy to non-UK destinations increased by 0.014 relative to the emigration rate of non-EU citizens. In other words, periods of uncertainty in migration policy following the Brexit vote encouraged potential migrants from Italy to relocate to alternative destinations. This finding contrasts with Di Iasio and Wahba (2023), who do not detect spillover effects or changes in the relative attractiveness of other EU destinations. Their result, based on the OECD International Immigration Database, captures an average effect across OECD countries, potentially masking cross-country heterogeneity. Moreover, their dependent variable is the log of gross migration flows, whereas ours is the emigration rate.

We conduct a placebo test using pre-treatment years to assess the validity of our identification strategy (Equation 2). The Wald test for the joint significance of the ATT coefficients in the pre-treatment period (Table 2.2) supports the parallel-trend assumption; Figure 2.5a corroborates

this result. A key contribution of our analysis, and one that justifies the use of a single-source-country migration dataset, is the assessment of whether citizenship heterogeneity matters for the impact of Brexit on migration behavior. The estimation of Model 2 (Table 2.2) confirms this hypothesis. When we distinguish EU citizens into two treatment groups—Italian citizens and Other-EU citizens—only the former exhibit a significant migration-diversion response to the Referendum shock. The coefficient τ associated with the dummy D_{it}(ATT)[11] for Italians indicates an increase of 0.015 in the emigration rate of Italians relative to non-EU citizens after the Referendum. It is significant at the 10% level. By contrast, the ATT coefficient for Other-EU citizens is positive but not statistically significant. The parallel-trend assumption is satisfied for Model 2 as well (see also Figure 2.5b and 2.5c).

Table 2.2 - TWFE estimates
Treatment groups: EU citizens, Italians, and Other EU citizens

	Model 1	Model 2	
	EU citizens	Italians	Other EU citizens
τ	0.014* (0.008)	0.015* (0.008)	0.012 (0.012)
Wald test (Chisq)	2.316 [0.509]	2.528 [0.470]	1.290 [0.732]

Notes: Outcome variable: the out-migration rate (from Italy to groups of countries, as defined in Section 4). The coefficient indicates the ATT parameter which is the migration diversion effect of the Brexit Referendum (τ). Standard errors are in parenthesis. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively. Inference is based on robust (against heteroskedasticity across groups) covariance matrix estimators according to the White method for panel models (Arellano, 1987). Observations are also clustered by "group" (i.e. by dyadic combinations *id*) to account for within-group serial correlation. The Wald test is the test of parallel trend assumption (joint significance of the ATT coefficient for the years before the treatment) (see equation 2). The P-value is in square brackets. Unbalanced panel: No. of cross-sectional units = 208; No. of years per cross-sectional units = 2-7; Total no. of observations = 1,413.

The absence of significant effects for Other-EU citizens may reflect the prevalence of return migration among this group. A substantial share (55.4%) consists of Romanians returning from Italy to Romania. This is consistent with evidence showing that these migrants are more likely

[11] In Models 2–3, heterogeneous effects are estimated by replacing the single treatment dummy D_{it} with multiple mutually exclusive indicators, each corresponding to one specific subgroup (e.g. Italians at birth, naturalised Italians born abroad, etc.). This approach allows us to estimate all group-specific effects within the same specification, ensuring comparability across groups and avoiding potential inconsistencies that may arise from estimating separate regressions on different sub-samples.

to accumulate social remittances (knowledge, skills) and economic remittances which can be reinvested in their origin country (Anghel et al. 2017). Similar patterns apply to Bulgarians, Poles, and other Eastern European citizens. Subsection 2.5.2 revisits this interpretation with robustness checks excluding return-migration flows from the dataset.

We now focus on the effect of Brexit on the outflows of Italian citizens. Table 2.3 reports TWFE estimates excluding the migration flows of Other-EU citizens and dividing Italians into two sub-groups: naturalized citizens and Italians by birth, the latter further disaggregated by education level (Model 3; Table 2.3). The parallel-trend assumption holds for all five treated groups (Figure 2.5d-2.5h).

Table 2.3 - TWFE estimates
Treatment groups: Naturalized Italians and Natives by Education Level

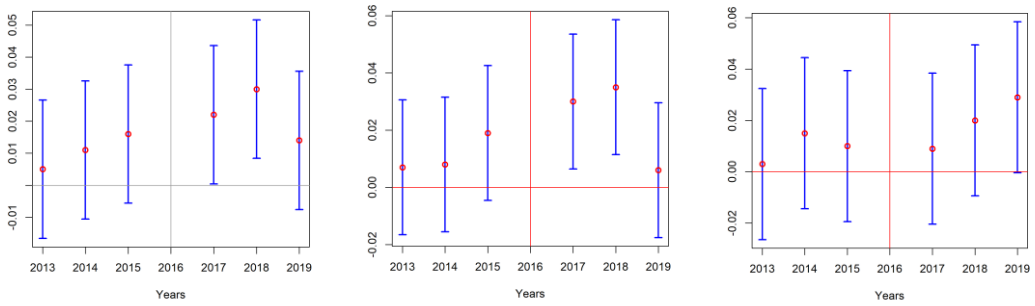
	Model 3				
	Naturalized born abroad	Naturalized born in Italy	Natives		
			High	Medium	Low
τ	0.019** (0.009)	0.003 (0.007)	0.020 (0.014)	0.011 (0.010)	0.024** (0.011)
Wald test (Chisq)	0.500 [0.919]	0.082 [0.994]	5.900 [0.117]	0.976 [0.807]	3.798 [0.284]

Notes: See Table 2.2. Unbalanced panel: No. of cross-sectional units = 168; No. of years per cross-sectional units = 2-7; Total no. of observations = 1,135.

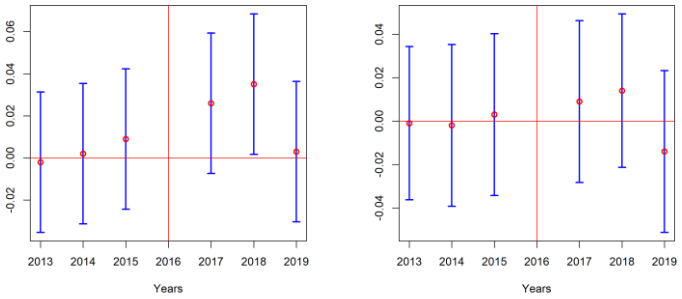
Interestingly, no significant diversion effect emerges for naturalized individuals born in Italy and for native Italians with high or medium education. By contrast, low-educated native Italians and naturalized born abroad are significantly affected by the Brexit shock, redirecting their migration towards non-UK destinations.

The coefficient for low-educated Italians (0.024) is statistically significant at the 5% level. This indicates that their emigration rate to non-UK countries increased by 0.024 relative to the counterfactual scenario without the Brexit shock. A similar diversion effect is found among naturalized individuals born abroad, whose socioeconomic characteristics may resemble those of low-educated natives. Their corresponding coefficient (0.019) is also significant at the 5% level. This suggests that more precarious labor-market positions may have heightened their sensitivity to post-Brexit uncertainty, encouraging a reorientation toward other destinations.

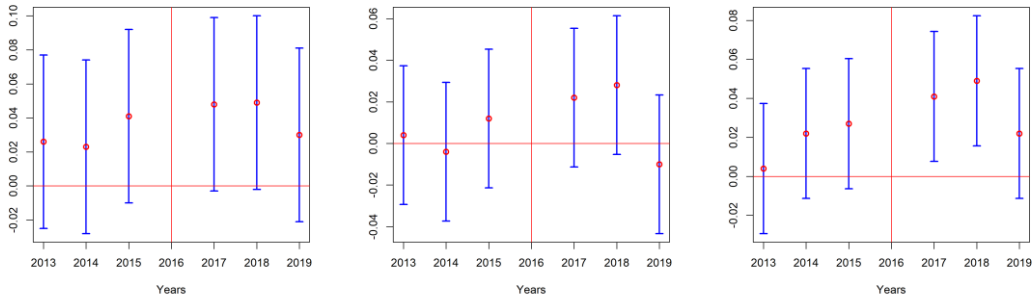
Figure 2.5 - Parallel trends of the outflows from Italy



a) Model 1 – EU citizens b) Model 2 – Italians c) Model 2 – Other EU



d) Model 3 – Naturalized born abroad e) Model 3 – Naturalized born in Italy



f) Model 3 – Italian Natives-High g) Model 3 – Italian Natives-Medium h) Model 3 – Italian Natives-Low
Note: Coefficient estimates are shown with 95% confidence intervals.

In contrast, no significant diversion effect emerges for highly skilled migrants or naturalized individuals born in Italy. The former may still feel welcomed in the UK after Brexit, much as highly skilled non-EU workers have traditionally been able to migrate there. The latter—whose processes of integration and socialization in Italy resemble those of native Italians—appear less

affected by perceived risks associated with Brexit.

2.5.2 Robustness checks

The results discussed above are based on TWFE estimates of a model that examines migration flows from Italy by individuals belonging to 19 distinct citizenship groups toward 16 destination groups (excluding the UK). The findings indicate that the uncertainty triggered by Brexit significantly influenced migration diversion only among native Italian citizens with low levels of education. Nevertheless, these results may be affected by two potential sources of bias.

First, as previously noted, some migration flows involving foreign citizens can be classified as return migration, a distinction enabled by the unique characteristics of our dataset. It is reasonable to assume that return migration is shaped by factors substantially different from those governing labor migration, and therefore is less likely to be influenced by the Referendum outcome. Second, the estimates presented thus far rely on an unbalanced panel, since all dyadic observations (citizenship–destination combinations) with zero migration flows were excluded. Such exclusion may introduce selection bias, insofar as a zero flow may represent a deliberate and meaningful decision by a given citizenship group not to migrate to a specific destination.

This section reports robustness checks designed to assess the relevance of these two potential sources of bias. Tables A2.3 and A2.4 in the Annex A2 present TWFE estimates for the same three models shown in Tables 2.2 and 2.3 of the main text, using the migration rate as the dependent variable, but excluding all flows classified as return migration. Overall, the results are qualitatively consistent with those in Tables 2.2 and 2.3: the only treated group significantly affected by Brexit in terms of migration diversion remains the group of low-educated Italian citizens, and the parallel-trend assumption is always satisfied. The main difference is that the treatment-effect coefficients reported in the Annex tables are smaller in magnitude but estimated with greater precision (i.e., they exhibit lower standard errors).

Finally, to evaluate the impact of excluding zero migration flows, we applied the pseudo-Poisson maximum likelihood estimator (Santos Silva and Tenreyro 2006) to a balanced dataset including 715 zero dyadic flows out of 2,128 possible flows (33%, obtained by multiplying the 304 dyadic flows by 7 years). The model includes fixed effects for each citizenship group, each destination group, and each year. The log of population size is included on the right-hand side as an offset term (i.e., a structural predictor with a fixed coefficient equal to 1). Standard errors are corrected for intra-cluster serial correlation using a three-way clustered variance–

covariance estimator. The results reported in Annex Table A2.5 are qualitatively in line with those obtained using the unbalanced panel. However, these pseudo-Poisson estimates should be interpreted with caution, as we encountered substantial difficulty in satisfying the parallel trend assumption —likely due to the high dispersion introduced by the large number of zero flows.

2.6 Conclusions

Has the Brexit referendum outcome altered the relative attractiveness of the UK compared with other foreign destinations for EU migrants? This study offers several key insights by adopting the perspective of a single country of origin—Italy—and provides evidence in support of the migration diversion hypothesis (H1). In other words, the policy uncertainty triggered by Brexit led EU citizens residing in Italy to behave differently from non-EU citizens, more frequently choosing destinations other than the UK. This result contrasts with the findings of Di Iasio and Wahba (2023), who report no evidence of migration diversion when considering OECD countries as a whole. Their result suggests that substantial cross-country heterogeneity may be masked by average effects.

Moreover, our findings highlight the value of using microdata and a longitudinal framework to examine specific subpopulations of interest, such as Italian-born individuals (by educational attainment), naturalized Italians, and other EU citizens, excluding British nationals. While the first version of the model reveals a clear migration diversion effect among all EU citizens emigrating from Italy—the overall treatment group—the multi-treatment specification shows that this effect is amplified for Italian citizens and not significant for other EU citizens, in line with hypothesis H2. When we further disaggregate the treated Italian group into naturalized citizens (born abroad or in Italy) and Italian-born individuals with different levels of educational attainment, we find that naturalized individuals born abroad and low-skilled Italian-born emigrants are those significantly affected by Brexit in terms of migration diversion.

This pattern suggests that uncertainty surrounding future access to labor markets and residence rights is more salient for migrants with weaker labor-market positions and lower expected returns, while highly educated individuals may anticipate continued opportunities even under a more selective regime.

Our results reinforce the connection between migration dynamics and uncertainty. Uncertainty

appears to be particularly influential for specific groups that are generally less likely to migrate. Although Brexit represents a unique event within the broader context of free mobility in the EU, our findings confirm that political uncertainty can shape migration flows as well as individuals' potential migration decisions. At the same time, the estimated effects are modest in magnitude, suggesting that Brexit-related uncertainty generated a measurable but limited reorientation of migration choices rather than a large-scale redirection of flows.

The limitations of our analysis stem from the nature of the data source, which, although providing detailed information on migrants, retains the typical constraints of administrative data. In particular, migration events are recorded only when they are reported to population registers, rather than at the time they actually occur. Despite this delay, we are confident that our findings remain robust, as this reporting bias is consistent across all migration events, regardless of migrants' nationality or destination.

Looking ahead, future research will examine the impact of post-Brexit policies on migration flows from Italy. Recent empirical evidence indicates a contraction of flows to the UK and the emergence of new destinations at the top of the ranking of receiving countries (Istat, 2025). However, the effects of the UK's new migration policy may be intertwined with those of the global pandemic during 2020–2022, which introduced additional uncertainties, particularly in the health sector, affecting both emigration and return migration.

Understanding the drivers of migration flows, the rise of new destination countries, and the influence of global uncertainties remains a key challenge for interpreting ongoing changes. Future research contributions can help build a more comprehensive picture of the motivations and consequences underlying these patterns, thereby providing useful insights for a more informed understanding of the phenomenon and for the development of more effective and better-targeted policies.

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A2. ANNEX

Table A2.1 - Aggregation of destination countries

Group	Destination Area Description
1	Belgium, Netherlands, Luxembourg
2	Denmark, Finland, Sweden
3	Spain, Portugal
4	Malta, Greece, Cyprus
5	Bulgaria, Romania
6	Germany, Austria
7	France
8	Ireland
9	Poland, Hungary, Estonia, Latvia, Lithuania, Croatia, Slovenia, Slovakia, Czech Republic
10	Africa
11	Asia
12	Brazil, Venezuela, Argentina
13	Other Central and South American countries
14	EFTA countries (Iceland, Liechtenstein, Switzerland, Norway)
15	Other non-EU European countries
16	USA, Canada, Oceania

Table A2.2 - Aggregation of citizenship groups

Group	Citizenship Group Description
1	Low-skill native Italians
2	Medium-skill native Italians
3	High-skill native Italians
4	Naturalized Italians (born in Italy)
5	Naturalized Italians (born abroad)
6	Western EU citizens **not** returning to their origin countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden)
7	Western EU citizens **returning** to their origin countries (same countries as above)
8	Eastern EU citizens **not** returning to their origin countries (Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia, Slovenia, plus Cyprus and Malta)
9	Eastern EU citizens **returning** to their origin countries (same countries as above)
10	Other European (non-EU) citizens from EFTA and other non-EU European countries **returning** to their origin countries
11	Other European (non-EU) citizens from EFTA and other non-EU European countries **not** returning to their origin countries
12	Asian citizens **returning** to their origin countries
13	Asian citizens **not** returning to their origin countries

Group	Citizenship Group Description
14	African citizens **returning** to their origin countries
15	African citizens **not** returning to their origin countries
16	North America & Oceania citizens **returning** to their origin countries
17	North America & Oceania citizens **not** returning to their origin countries
18	Central & South America citizens **returning** to their origin countries
19	Central & South America citizens **not** returning to their origin countries

Table A2.3 - TWFE estimates, excluding return migrations
Treatment groups: EU citizens, Italians, and Other EU citizens

	Model 1	Model 2	
	EU citizens	Italians	Other UE citizens
τ	0.007** (0.003)	0.010** (0.004)	0.001 (0.005)
Wald test (Chisq)	2.836 [0.418]	5.312 [0.150]	0.349 [0.951]

Notes: Outcome variable: the out-migration rate (from Italy to groups of countries, as defined in Section 4). The coefficient indicates the ATT parameter, which is the migration diversion effect of the Brexit Referendum (τ). Standard errors are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively. Inference is based on robust (against heteroskedasticity across groups) covariance matrix estimators according to the White method for panel models (Arellano, 1987). Observations are also clustered by "group" to account for within-group serial correlation. The Wald test is the test of parallel trend assumption (joint significance of the ATT coefficient for the years before the treatment) (see equation 2). The P-value is in square brackets. Unbalanced panel: No. of cross-sectional units = 192; No. of years per cross-sectional units = 2-7; Total no. of observations = 1,301.

Table A2.4 - TWFE estimates, excluding return migrations
Treatment groups: Naturalized Italians and Natives by Education Level

	Model 3				
	Naturalized born abroad	Naturalized born in Italy	Natives		
			High	Medium	Low
τ	0.013** (0.006)	-0.002 (0.002)	0.014 (0.011)	0.005 (0.006)	0.018** (0.009)
Wald test (Chisq)	0.368 [0.947]	0.153 [0.984]	4.752 [0.123]	1.587 [0.662]	2.884 [0.487]

Notes: See Table A1. Unbalanced panel: No. of cross-sectional units = 160; No. of years per cross-sectional units = 2-7; Total no. of observations = 1,079.

Table A2.5 - Pseudo-Poisson estimates
Treatment groups: EU citizens, Italians, and Other EU citizens

	Model 1		Model 2		
	EU citizens		Italians		Other UE citizens
τ	0.232** (0.095)		0.255** (0.111)		0.067 (0.091)
	Model 3				
	Naturalized born abroad	Naturalized born in Italy	Natives		
			High	Medium	Low
τ	1.123*** (0.134)	-0.142 (0.114)	0.133 (0.081)	0.095 (0.082)	0.231*** (0.083)

Notes: Outcome variable: the out-migration flows (from Italy to groups of countries, as defined in Section 4). The estimates include the population as an offset term, and fixed effects for nationalities, destinations, and years. The coefficient indicates the ATT parameter, which is the migration diversion effect of the Brexit Referendum (τ). Standard errors are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively. Observations are also clustered by "group" to account for within-group serial correlation. Balanced panel: total no. of observations = 2,128.

Chapter 3. Spatial convergence in aging: the role of migration

Francesca Licari, Roberto Basile, Cinzia Castagnaro[12], and Francesca Centofanti[13]

Abstract

Population aging challenges welfare systems, particularly in rapidly aging countries such as Italy. Using municipality-level data (2002–2023), this paper examines aging dynamics through the Potential Support Ratio (PSR), the ratio of working-age (15–64) to old-age (65+) population. We apply a beta regression framework to analyze spatial convergence and a two-step decomposition to disentangle the contributions of cohort turnover, mortality, and migration. Findings show strong convergence in aging, with international migration partly mitigating demographic imbalance, while internal migration exacerbates it, increasing fragility in peripheral areas. Policy implications highlight the need to strengthen welfare sustainability and regional equity.

Keywords: Population aging, Migration, Beta convergence, Demographic decomposition, Potential support ratio, Italy.

Jel codes: F22, J61, R23, C14, C21

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3.1 Introduction

Population aging has become one of the most salient demographic challenges facing advanced economies, with profound implications for welfare sustainability, labor markets, and regional development. Within the framework of demographic transition theory (Notestein, 1945; Chesnais, 1992), population aging is understood as the combined outcome of persistently low fertility and sustained improvements in survival, which progressively alter the age composition of populations by shrinking younger cohorts and expanding older ones. Italy represents an extreme case within this broader trend. Persistently low fertility, rising life expectancy, and long-standing territorial disparities have combined to produce one of the fastest aging populations worldwide (Billari and Galasso, 2009). As a result, the balance between working-age and elderly populations has deteriorated rapidly, raising concerns about the capacity of local communities and institutions to sustain economic activity and social protection systems (Bloom et al., 2010).

While population aging is a nationwide phenomenon, its intensity and underlying drivers vary markedly across space. A growing body of demographic research emphasizes that aging is not only a temporal process, but also a spatially differentiated one, shaped by the uneven distribution of fertility, mortality, and migration across territories. In Italy, demographic change has unfolded unevenly across regions and municipalities, reflecting historical differences in reproductive behavior, mortality improvements, and migration trajectories (Caselli et al., 2014; Bonifazi et al., 2021). Over the past two decades, macro-regional disparities in aging have narrowed, suggesting a process of spatial convergence (Kashnitsky et al., 2017; Gutiérrez Posada et al., 2018). Yet this apparent convergence masks substantial heterogeneity at finer territorial scales, particularly between dynamic urban areas and peripheral or inner regions that have experienced sustained population decline and selective outmigration (Reynaud et al., 2020). This pattern is consistent with theoretical accounts highlighting how aggregation at higher spatial levels may conceal localized divergence driven by selective mobility and cumulative demographic processes (Openshaw, 1984).

Migration plays a central and theoretically ambiguous role in this context. In demographic theory, migration has long been discussed as a potential compensatory mechanism in aging societies, most notably in the concept of replacement migration (United Nations, 2001), which

frames inflows of younger individuals as a possible offset to declining working-age populations. At the same time, migration theory increasingly emphasizes that mobility is selective by age, education, and labor-market position, and therefore unlikely to produce neutral or evenly distributed demographic effects (Greenwood, 1985). In Italy, international migration has contributed to replenishing the working-age population in several areas, partly mitigating the demographic imbalance generated by low fertility (Bonifazi et al., 2009). Conversely, internal migration, especially the movement of young and educated individuals from peripheral areas toward central and metropolitan regions, has intensified territorial disparities, accelerating aging in already fragile local systems (Svimez, 2019; Cersosimo and Donzelli, 2020). From this perspective, migration does not simply counteract aging but actively redistributes age structures across space, reinforcing center–periphery divides (Rees et al., 2017).

Despite a growing literature on population aging and regional convergence, empirical evidence remains limited in several respects. First, most studies rely on aggregate regional data, which may obscure important dynamics occurring at the local level, where demographic change is often most pronounced (Kulu and Vikat, 2007). Second, the relationship between migration and aging is characterized by strong endogeneity: migration both responds to existing demographic structures and reshapes them through selective mobility, complicating causal interpretation (Plane et al., 2005). Third, relatively few contributions explicitly decompose observed convergence patterns into their underlying demographic components—mortality, cohort turnover, and migration—thereby limiting our understanding of the specific mechanisms through which spatial aging trajectories emerge and evolve.

This chapter addresses these gaps by analyzing population aging in Italy using municipality-level data on population stocks and flows between 2002 and 2023. We focus on the Potential Support Ratio (PSR), defined as the ratio of the working-age population (15–64)[14] to the old-age population (65+), as indirect measure of aging. A lower PSR indicates a greater burden on the active population to sustain retirees, pensions, and healthcare systems.

The analysis proceeds in two steps. First, we apply a beta regression framework to assess

[14] The 15-64 age group is a conventional representation of the working-age population that may not be realistic. Still, it is a standard measure and, therefore, useful in our analysis to assess changes in territories with different demographic and labor supply patterns.

spatial convergence in aging, building on approaches by Kashnitsky et al. (2017), Gutiérrez Posada et al. (2018), and Backman and Karlsson (2024). Second, we employ a two-step decomposition method (Kashnitsky et al., 2017) to disentangle the contributions of different demographic components, cohort turnover, mortality, and migration, to changes in PSR. This approach circumvents endogeneity issues affecting standard econometric models and allows a clearer assessment of migration's role in shaping aging trajectories.

Our analysis is guided by three research questions: *i*) Is Italy experiencing spatial convergence in aging at the municipal level, and to what extent? *ii*) What is the relative contribution of migration, mortality, and cohort turnover to observed changes in the Potential Support Ratio? *iii*) How do international and internal migration differentially shape local demographic trajectories, and what territorial imbalances do they generate?

By addressing these questions, this chapter contributes to the literature on demographic change, migration, and spatial convergence in three ways. It provides fine-grained evidence on aging dynamics in one of the world's most rapidly aging countries; it clarifies the role of migration as both a mitigating and a polarizing force; and it offers insights relevant for place-based policies aimed at sustaining demographic balance and regional cohesion.

The remainder of the chapter is organized as follows. Section 3.2 presents the theoretical background and reviews the relevant literature; Section 3.3 describes the methodology; Section 3.4 discusses descriptive patterns of aging across Italian municipalities; Section 3.5 presents the econometric results, and Section 3.6 concludes with policy implications.

3.2 Theoretical background: aging, migration, and spatial convergence

Demographic change unfolds unevenly across space. Even when fertility and mortality trends are broadly similar at the national level, local age structures may evolve along markedly different trajectories depending on initial conditions and population movements. This spatial dimension is central to understanding population aging, whose economic and social consequences (pressure on pension systems, healthcare provision, and intergenerational transfers) are not evenly distributed across territories.

In advanced economies, aging reflects long-term demographic processes driven by sustained reductions in fertility and continuous improvements in survival. Socioeconomic progress has

extended life expectancy and reduced mortality risks (World Health Organization, 2020), while persistently low fertility has reduced the size of younger cohorts entering the labor market. The joint effect of these trends is a growing imbalance between the working-age population and older cohorts, commonly captured by the old-age dependency ratio or its inverse, the Potential Support Ratio (PSR). A declining PSR signals increasing pressure on the active population to sustain retirees and welfare systems, with implications for economic growth and fiscal sustainability (Bloom et al., 2015; Feldstein, 2006; Bloom and Luca, 2016).

The literature has traditionally identified two main demographic levers to counteract aging. The first is fertility: policies supporting families and female labor market participation may raise birth rates, but their effects materialize only in the long run, as new cohorts require decades to enter the workforce. The second is migration: inflows of younger, economically active individuals can provide a more immediate demographic adjustment by replenishing the working-age population and, indirectly, sustaining future population growth through higher fertility levels (Coleman, 1995; Leers et al., 2004; Findlay and Wahba, 2013; Neumann, 2013). Nevertheless, while migration is widely recognized as a potential buffer against aging, its capacity to stabilize demographic balances remains contested.

The PSR is a widely used indirect measure of demographic aging (UN Population Division, 2000). Lower PSR values indicate a heavier demographic burden on the active population. The United Nations' Replacement Migration report (2000) showed that immigration could slow the decline in PSR in most developed countries but not fully stabilized it. Subsequent research confirmed that even under alternative definitions of working-age and old-age thresholds, migration volumes required to fully offset aging would be unrealistically large (Craveiro et al., 2019). These findings suggest that migration can mitigate, but not neutralize, long-term aging trends.

This demographic challenge is particularly acute in Europe. According to Eurostat (2023), the EU old-age dependency ratio increased from 27.7% on January 1st, 2013, to 33.4% on January 1st, 2023, with especially high levels in countries such as Portugal, Italy, and Finland. Italy represents an extreme case: between January 1st, 2002 and January 1st, 2024, its old-age dependency ratio rose from 27.9% to 38.3%, making it one of the most aged populations worldwide. At the same time, broad regional differences in aging have narrowed (Basile et al., 2022). In the North, the dependency ratio increased from 29.6% on January 1st, 2002 to 39.2%

on January 1st, 2024; in the Center from 30.4% to 39.5%; and in the South (including Sicily and Sardinia) from 24.3% to 36.5% (Istat, 2024). Yet significant spatial heterogeneity persists at finer scales (NUTS-2, NUTS-3, municipalities), reflecting the differentiated impact of demographic drivers across territories. Particularly, Italy's "Inner Areas" have experienced depopulation and youth outmigration, exacerbating demographic fragility (Monturano et al., 2023).

From a spatial perspective, an important question is whether aging dynamics exhibit convergence across territories. A growing body of research applies concepts of beta-convergence to demographic indicators, finding that areas with initially younger populations tend to age faster, thereby reducing regional disparities over time (Gutiérrez Posada et al., 2018; Backman and Karlsson, 2024). However, convergence in aggregate indicators may conceal offsetting demographic forces. Mortality dynamics often promote convergence, while cohort turnover and migration can generate divergence by redistributing younger populations toward economically dynamic areas (Wu et al., 2019; Wu et al., 2021).

Migration plays a particularly ambiguous role in this framework. While international inflows may rejuvenate receiving areas, internal migration often reinforces spatial polarization by draining working-age individuals from peripheral and declining regions. Moreover, migration decisions are endogenous to local demographic and economic conditions: migrants are less likely to settle in aging regions, while outmigration itself accelerates aging, complicating causal interpretations (Prenzel, 2021). As a result, standard econometric approaches may struggle to disentangle the contribution of migration from other demographic components.

These considerations motivate an analytical framework that jointly examines spatial convergence in aging and decomposes demographic change into its underlying drivers. By focusing on the PSR[15] and disentangling the roles of cohort turnover, mortality, and migration, it becomes possible to assess whether observed convergence reflects genuine demographic equalization or the coexistence of opposing territorial dynamics.

This approach is particularly suited to the Italian context, where long-standing regional inequalities and intense internal mobility interact with international migration to shape local aging trajectories.

[15] The choice of the PSR as the main indicator is also motivated by analytical considerations. Unlike the old-age dependency ratio, the PSR places the working-age population in the numerator, which is crucial for the decomposition framework adopted in this study.

3.3 Methodology

3.3.1 Beta regression approach

For each Italian municipality, we calculate the Potential Support Rate (PSR_t) as the ratio between the population aged 15-64 (W_t) and the population aged 65 and over (O_t) at the beginning of each year t (January 1st, year t). To assess convergence in PSR across municipalities, we estimate the following beta regression equation:

$$PSR_t - PSR_{t-1} = \alpha + \beta PSR_{t-1} + \varepsilon_t \qquad (1)$$

A negative β parameter indicates absolute convergence in PSR: municipalities with lower PSR values at time $t-1$ tend to catch up with those having higher values, and *vice versa*.[16]

Following Kashnitsky et al. (2017), we decompose the variation in PSR into two steps. First, the change in PSR is separated into an old-age component and a working-age component:

$$PSR_t - PSR_{t-1} = \left[\frac{1}{2}(W_t + W_{t-1})\left(\frac{1}{O_t} - \frac{1}{O_{t-1}}\right)\right] + \left[\frac{1}{2}\left(\frac{1}{O_t} + \frac{1}{O_{t-1}}\right)(W_t - W_{t-1})\right] \quad (2)$$

The second step further decomposes the working-age component - $\left[\frac{1}{2}\left(\frac{1}{O_t} + \frac{1}{O_{t-1}}\right)(W_t - W_{t-1})\right]$ - using the following dynamic equation:

$$W_t = W_{t-1} + CT_{t-1} + M^w_{t-1} - D^w_{t-1} + \Delta^w_{t-1} \qquad (3)$$

where $CT_{t-1} = P^{14}_{t-1} - P^{64}_{t-1}$ represents cohort turnover. Here, P^{14}_{t-1} and P^{64}_{t-1} denote the populations aged 14 and 64, respectively, on December 31 of year $t-1$. M^w_{t-1} is the net migration of working-age population between January 1st of year $t-1$ and December 31st of year $t-1$, defined as the balance between inflows and outflows recorded in the municipal registry due to both internal and international migration. D^w_{t-1} is the number of deaths among the working-age population during the same period. Finally, Δ^w_{t-1} is a statistical adjustment for administrative revisions, capturing discrepancies between the population at the beginning and the end of the period (see footnote 7).

[16] An alternative concept to the β-convergence is the σ-convergence. The latter looks at regional inequalities and analyzes whether the spatial dispersion of the aging (measured by the standard deviation or the coefficient of variation) shrinks or not. A necessary condition for the existence of σ-convergence is the existence of β-convergence (Barro and Sala-i-Martin, 1991).

Based on equation (3), the working-age component can be decomposed as:

$$\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)(W_t - W_{t-1}) = \left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)CT_{t-1}\right] + \left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)M^w_{t-1}\right] - \left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)D^w_{t-1}\right] + \left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)\Delta^w_{t-1}\right] \quad (4)$$

We then estimate the beta regression separately for each component:

$$\left[\frac{1}{2}(W_t + W_{t-1})\left(\frac{1}{O_t}-\frac{1}{O_{t-1}}\right)\right] = \alpha^o + \beta^o PSR_{t-1} + \varepsilon_t \quad (5;\ \textit{Old-age})$$

$$\left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)(W_t - W_{t-1})\right] = \alpha^w + \beta^w PSR_{t-1} + \varepsilon_t \quad (6;\ \textit{Working-age})$$

$$\left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)CT_{t-1}\right] = \alpha^{ct} + \beta^{ct} PSR_{t-1} + \varepsilon_t \quad (7;\ \textit{Cohort-turnover})$$

$$\left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)M^w_{t-1}\right] = \alpha^{mg} + \beta^{mg} PSR_{t-1} + \varepsilon_t \quad (8;\ \textit{Migration})$$

$$\left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)D^w_{t-1}\right] = \alpha^{dt} + \beta^{dt} PSR_{t-1} + \varepsilon_t \quad (9;\ \textit{Deaths})$$

$$\left[\frac{1}{2}\left(\frac{1}{O_t}+\frac{1}{O_{t-1}}\right)\Delta^w_{t-1}\right] = \alpha^{\Delta} + \beta^{\Delta} PSR_{t-1} + \varepsilon_t \quad (10;\ \textit{Stat.-Adj.})$$

The overall convergence parameter is given by[17]:

$$\beta \equiv \beta^o + \beta^w \qquad (11)$$

and, for the working-age component:

$$\beta^w \equiv \beta^{ct} + \beta^{mg} + \beta^{dt} + \beta^{\Delta} \qquad (12)$$

A negative β in equation (11) implies convergence in PSR across municipalities. The

[17] Because PSR change is additively decomposed into mutually exclusive components, and all equations are estimated on the same left-hand-side scale with the same regressor PSR_{t-1}, the OLS estimator is linear in the dependent variable. Therefore, the overall β is algebraically equal to the sum of the component-specific β coefficients. However, this additivity reflects an accounting identity — not independent causal effects — since demographic components may influence each other dynamically

decomposition further indicates whether convergence is primarily driven by old-age dynamics (β^o) or by working-age factors (β^w).

It is reasonable to expect a negative sign for the overall β, as evidence from other studies also suggests a gradual but steady catching-up process in aging across regions in Italy. Given the widespread decline in mortality and the rise in life expectancy throughout Italy, a negative β^o is also expected. By contrast, the coefficient for migration (β^{mg}) is likely to be positive, as migration typically generates divergent aging patterns (Smailes et al., 2014; Bloom et al., 2003). For instance, urban areas attract young and often highly educated individuals, thereby rejuvenating local populations, while rural and peripheral areas lose working-age cohorts, accelerating their demographic aging. As argued by Backman and Karlsson (2024), migration thus contributes to greater spatial heterogeneity in age structures.

3.3.2 Varying-coefficient models

A limitation of the previous approach is the assumption of homogeneous β coefficients over time. In this study, we are particularly interested in the time-varying contributions of different components to the overall convergence process. Such heterogeneity can be modeled using semiparametric methods. Specifically, the beta-convergence equation can be reformulated to allow for time-varying coefficients:

$$y_{it} = \alpha + f(t) + f(t)x_{it} + \varepsilon_{it} \qquad (13)$$

Here, y_{it} denotes the dependent variable (where i=spatial unit and t=year), defined either as the change in PSR ($PSR_{i,t} - PSR_{i,t-1}$) or as one of its components, as described in equations (2) and (4). The regressor x_{it} corresponds to the initial condition ($PSR_{i,t-1}$), while $f(t)$ is a nonparametric smooth function of time estimated using penalized regression splines (Eilers and Marx, 1996; De Boor, 1977). By interacting $f(t)$ with the continuous term x_{it}, the model allows the coefficient of x_{it} to vary smoothly over time.

However, equation (13) does not account for observable or unobservable factors that may influence PSR dynamics. An omitted-variable bias could arise if such confounders affect both the dependent and independent variables. Since the regressor x_{it} is predetermined at time $t-1$, simultaneity concerns are mitigated, but issues of reverse causality remain. To reduce endogeneity risks, we refrain from including additional demographic indicators on the right-

hand side of equation (13), as they are strongly endogenous.

To capture unobserved spatial and temporal heterogeneity, we extend the model by incorporating a spatiotemporal trend, $g(long_i, lat_i, t)$, defined as a smooth interaction between geographic coordinates and time:

$$y_{it} = \alpha + f(t)x_{it} + g(long_i, lat_i, t) + \varepsilon_{it} \quad (14)$$

Direct estimation of $g(.)$ can be computationally intensive for large datasets. Therefore, we adopt a spatiotemporal ANOVA decomposition (Lee and Durbán, 2011), which separates the trend into main spatial and temporal effects, as well as their second- and third-order interactions:

$$y_{it} = \alpha + f(t)x_{it} + g_1(long_i) + g_2(lat_i) + g_t(t) + g_{1,t}(long_i, t) + g_{2,t}(lat_i, t) + g_{1,2}(long_i, lat_i) + g_{1,2,t}(long_i, lat_i, t) + \epsilon_{it}$$

The model is estimated via penalized regression, combining basis representations of the unknown functions with smoothness penalties. We use the cubic B-spline method introduced by Eilers and Marx (1996), which applies second-order differences of adjacent coefficients as penalties.[18]

Two additional methodological issues deserve discussion. First, municipalities differ substantially in population size, ranging from very small localities to large metropolitan areas. Although the use of ratios such as the Potential Support Ratio mitigates scale effects, age structures in very small municipalities may be more volatile due to demographic stochasticity and selective migration. To address this concern, our specification incorporates smooth spatial and spatio-temporal components, which help absorb systematic differences related to local demographic contexts and reduce the influence of extreme fluctuations. Nevertheless, we acknowledge that residual noise may persist at very small scales, and future work could explore weighting schemes or alternative smoothing strategies to further account for population-size heterogeneity.

Second, ageing dynamics may exhibit spatial autocorrelation, as demographic trajectories in one municipality can be correlated with those of neighboring areas through shared labor

[18] We use the gam() function included in the mgcv R package to estimate the model.

markets, migration networks, and institutional environments (Benassi et al., 2023). In our framework, spatial dependence is handled in a flexible, non-parametric way through smooth spatial and spatio-temporal trends, which capture broad spatial clustering and common regional patterns in the evolution of the PSR. While this approach does not explicitly model local spillovers via spatial lag or spatial error structures, it allows us to control spatially correlated processes without imposing strong parametric assumptions. Explicit modeling of inter-municipal spatial interactions represents a natural extension of the present analysis.

3.4 Spatial distribution of aging in Italy

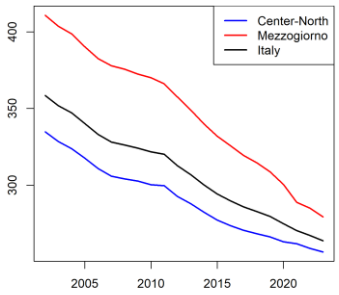
This section reports the results of the analysis of the spatial distribution of aging in Italy over the period 2002–2023. Aging is measured using the Potential Support Ratio (PSR), calculated as the number of individuals of working age (15–64) per 100 older adults (65 and over). The municipality is the unit of analysis, and all data are drawn from Istat.[19]

Italy is among the Western countries that have experienced the sharpest increase in population aging over the past two decades. Accordingly, the national aggregate PSR has declined monotonically from 2002 to 2023, with the steepest reduction occurring in the last 12 years (Figure 3.1a). From an initial value of 358 in 2002, the PSR fell to 264 in 2023, meaning that the working-age population declined from about 3.5 times the size of the old-age population to only 2.5 times. This trend is consistent with previous studies on demographic aging in Italy (e.g., Tomassini and Lamura, 2009; De Rose et al., 2019).

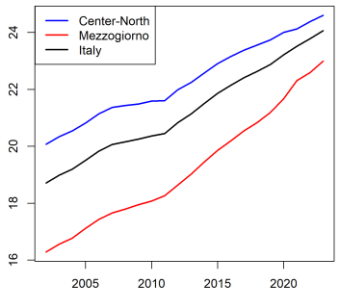
A second key feature of the aging process is its uneven spatial distribution. At the macro-regional level, the gap in PSR values between the Center-North (hereafter, referred to as "North") and the South (referred to in the figure as Mezzogiorno, including southern regions and islands) has significantly narrowed, though it has not disappeared (Figure 3.1a).

[19] We use postcensal estimates for population size, births, and deaths for the period 2002–2018. From 2019 onward, we rely on ISTAT data from the Permanent Census. Migration flows for 2002–2023 are derived from changes of residence (ISTAT). To ensure demographic consistency, we also include a residual factor that accounts for administrative adjustments and, from 2019, Census over- and under-coverage. *Under-coverage* refers to the inclusion in the resident population of individuals who have provided "signals of life" in the area (from integrated administrative records such as tax filings, residence permits, etc.). *Over-coverage* refers to the exclusion of individuals who no longer show such signals of life from the resident population count.

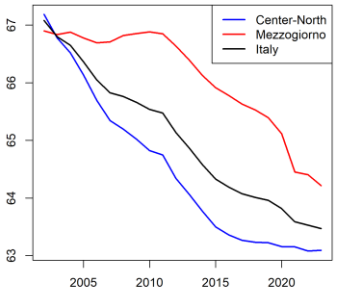
Figure 3.1 - Demographic trends: Center-North and South aggregated statistics



(a) PSR*100



(b) O/P*100



(c) W/P*100

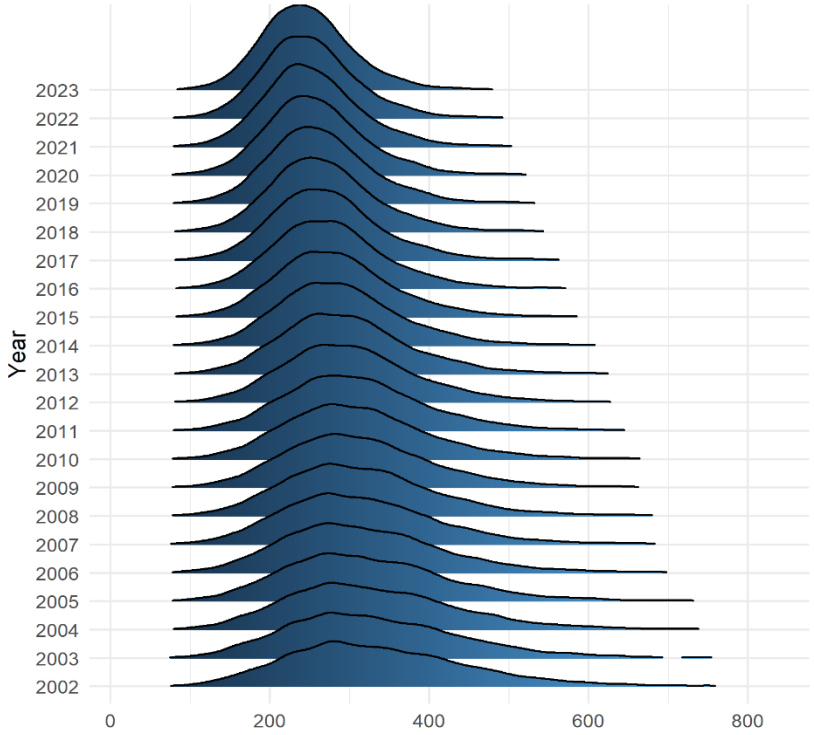
Source: Our elaborations on Istat data.

In 2002, the PSR in the South was 410, compared to 334 in the Center-North. This difference mainly reflected a lower share of older adults in the South (Figure 3.1b), since the working-age shares were initially similar in both areas (Figure 3.1c). The lower share of elderly in the South can be explained by higher fertility rates recorded there between the 1970s and early 1990s, which sustained the working-age population until about 2012 (Figure 3.1c). After that, the working-age population in the South started to decline rapidly, while the old-age share increased more steeply (Figure 3.1b). As a result, the PSR gap between the two macro-areas narrowed substantially in the last decade: in 2023, the PSR was 279 in the South and 256 in the Center-North.

At a finer spatial scale, the reduction in heterogeneity is even clearer. The coefficient of

variation of municipal PSR values decreased steadily over time, supporting the sigma-convergence hypothesis (see footnote 17) (Figure A3.1, Annex A3.). Kernel density estimates also reveal substantial changes in the distribution of PSR across municipalities (Figure 3.2).

Figure 3.2 - Municipality PSR: univariate density estimates



Source: Our elaborations on Istat data.

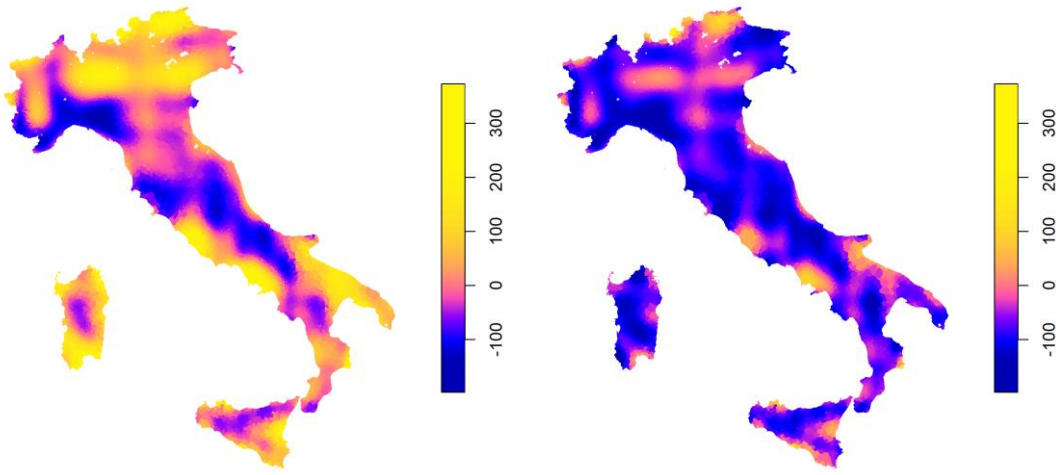
While the left tail of the distribution (lowest PSR values) remained stable (Table A3.1, Annex A3), the right tail (highest PSR values) became thinner and shorter, showing increasing concentration around the interquartile range. This indicates that the national decline in PSR was largely driven by municipalities initially in the right tail, those with the highest PSR values, that gradually converged towards the national average. In 2002, 16.5% of municipalities (representing 23.6% of the total population) had PSR values above 450; by 2023, this share had fallen to just 0.5% of municipalities (0.5% of the population).

The spatiotemporal trend model[20] provides further insights. In 2002, low PSR values (in blue,

[20] The spatiotemporal trend model of the PSR is specified as follows: $PSR_{it} = \alpha + f(s_{1i}, s_{2i}, t) + \varepsilon_{it}$, where PSR_{it} is the potential support ratio of each Italian municipality i at time t; $f(s_{1i}, s_{2i}, t)$ is the

Figure 3.3a) were concentrated in Liguria, Lower Piedmont, Tuscany, and mountainous areas of Abruzzo and Molise. By contrast, clusters of high PSR values (in yellow) were located in Lombardy, Veneto, the autonomous province of Bolzano, coastal areas of the South, and the Lazio region.[21] The low PSR levels in Liguria and Lower Piedmont are linked to deindustrialization following the decline of the Fordist model in the "Industrial Triangle" during the 1970s, combined with the rise of "Third Italy" industrial districts.[22] This shift triggered outmigration from Liguria and Piedmont towards other industrial districts, leading to population loss and aging in the former and higher PSR values in the latter (Bonifazi et al., 2021).

Figure 3.3 - Spatiotemporal trend analysis



(a) 2002 (b) 2023

Source: our elaboration on Istat data.

At the same time, globalization fostered international migration, with foreign workers attracted

spatiotemporal trend, representing a smooth interaction between latitude, longitude, and year; α is a constant term; and ε_{it} is the i.i.d. error term.

[21] Similar evidence is obtained using local Moran I and local G* statistics (see Annex A3.).

[22] The expression "industrial triangle" refers to the three major cities (Milan, Turin, and the seaport of Genoa), where the heavy manufacturing sectors were concentrated until the first oil shock in the early 1970s which led to the crisis of the Fordist model. The expression "Third Italy" describes specialized clusters of small-and-medium-sized firms (so-called industrial districts) in the northeast and in the Center that emerged during the 1970s.

to industrial areas. In Abruzzo and Molise, the early low PSR levels reflected persistent outmigration, especially after 1992 when state subsidies to local industries (via the "Cassa del Mezzogiorno") were abruptly withdrawn. Conversely, the higher PSR values observed in the coastal South reflect the concentration of working-age populations in these densely populated areas.

By 2023, the spatial distribution of PSR had shifted substantially. Figure 3b illustrates the widespread decline in PSR values across the country. The highest PSR values are now confined to the autonomous province of Bolzano, long recognized for its high fertility and low aging rates, and to some metropolitan areas in the Center and South, including Rome, Naples, Catania, and parts of coastal Puglia.

3.5 Econometric results

In this section, we present the results of the absolute and conditional beta convergence analyses (Eqs. 13–14). In the case of absolute convergence, a negative beta coefficient indicates that municipalities with initially high PSR values tend to catch up with those with initially low values. In the conditional specification (i.e. including the spatiotemporal trend), a negative coefficient suggests that PSR values converge across municipalities with similar observable and unobservable characteristics.

Table 3.1 reports the mean values of the decomposition.

Table 3.1 - Beta-convergence analysis: mean values of time varying beta parameters

Beta coefficient	Absolute	Conditional
Overall beta		
β	-0,044	-0,041
First step decomposition		
β^{o}	-0,054	-0,056
β^{w}	0,01	0,016
Second step decomposition		
β^{ct}	0,014	0,008
β^{mg}	-0,001	0,01
β^{dt}	-0,002	-0,001
β^{Δ}	-0,001	-0,002

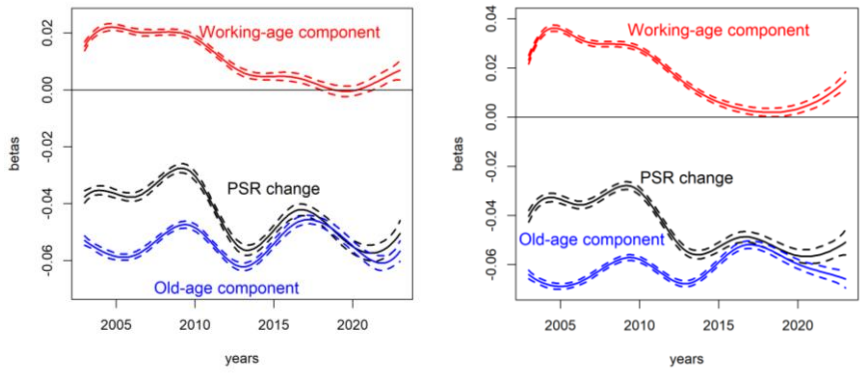
Source: Our elaboration on Istat data.

Figures 3.4–3.6 display the time-varying coefficients,[23] Figures 3.4 and 3.5 provide a further breakdown of the PSR changes, distinguishing between the first-step (old-age vs. working-age) and second-step (cohort turnover, mortality, and migration) components. The horizontal axis shows the years, and the vertical axis the estimated beta coefficients (panel a: absolute convergence; panel b: conditional convergence). Dashed lines represent 95% confidence intervals. Figure 3.6 adds the decomposition of net migration into its internal and international components.

3.5.1 Beta convergence analysis: first-step decomposition

When the overall change in PSR is used as the dependent variable (black line, Figure 3.4a), all estimated beta coefficients are negative, with a mean value of –0.044 (one-percentage-point increase in the PSR at time $t-1$ leads to an average decrease of 4.4 percent in the PSR at time t). This indicates absolute convergence: municipalities with higher initial PSR values experienced faster declines, thus catching up with those with lower initial values. The effect is robust to the inclusion of spatiotemporal heterogeneity (Figure 3.4b). Figure 3.4 also decomposes the convergence process into the contributions of the old-age and working-age populations.

Figure 3.4 - Beta-convergence: First step



(a) Absolute convergence (b) Conditional convergence

Source: Our elaborations on Istat data.

[23] Given the large difference in the size of municipalities, in all regressions spatial units have been weighted using the total population as weight.

The results clearly show that convergence is mainly driven by the old-age component. The corresponding beta coefficients are consistently negative, with mean values (β^o in Table 3.1) of –0.054 (absolute) and –0.056 (conditional). By contrast, the working-age component displays positive beta coefficients, with means (β^w in Table 3.1) of 0.010 and 0.016, implying a diverging effect that partially offsets the overall convergence.

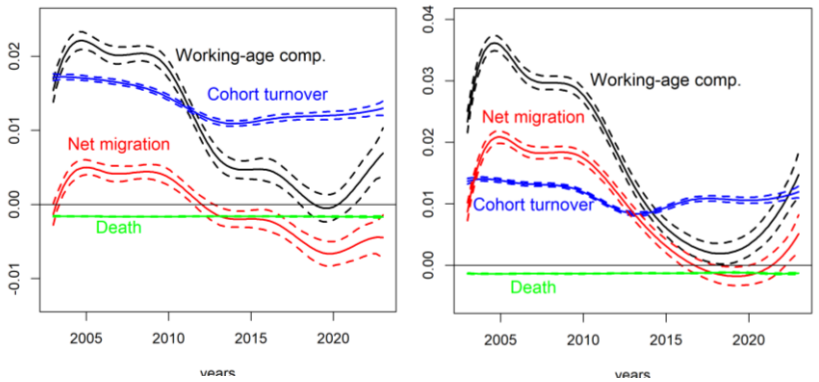
The dynamics were not constant over time. In the early 2000s, beta values were closer to zero, reflecting slower convergence, with a peak in 2009. Convergence accelerated thereafter, consistent with the rapid PSR decline observed in Southern municipalities (Figure A3.4, Annex A3). This acceleration suggests that regional disparities in demographic aging narrowed substantially in the last decade. The spatial patterns reinforce this interpretation. (Figure A3.5, Annex A3) shows that in both 2002–2012 and 2012–2023, changes in the old-age component closely track the overall PSR decline (Figure A3.5, panel a and b), while the working-age component contributed to divergence only in the early period. Between 2002 and 2012, municipalities with initially high PSR values, such as Lombardy, Veneto, Bolzano, and some southern coastal zones, recorded stronger working-age dynamics (Figure A3.5, panel c), which slowed convergence. In contrast, during 2012–2023, working-age changes turned negative almost everywhere, particularly in the South, accelerating convergence (Figure A3.5, panel d).

3.5.2 Second-step decomposition

We now decompose the working-age component into cohort turnover, mortality, and migration (Figure 3.5). The mortality component consistently shows a convergent effect, but its magnitude is negligible (average beta around –0.002). The cohort turnover component, by contrast, exerts a diverging effect, with average betas of 0.014 (absolute) and 0.008 (conditional).[24] The migration component displays a more nuanced pattern. In the absolute convergence specification, the estimated coefficient suggests a small convergent effect, with an average β close to zero (average β^{mg} –0.001). However, once unobserved spatial and temporal heterogeneity is accounted for in the conditional model, this effect reverses sign and becomes positive (0.010), indicating that migration contributes to divergence in the PSR across municipalities.

[24] The statistical adjustment component plays also a marginal role all over the period.

Figure 3.5 - Beta-convergence: Second step



(a) Absolute convergence (b) Conditional convergence

Source: Our elaborations on Istat data.

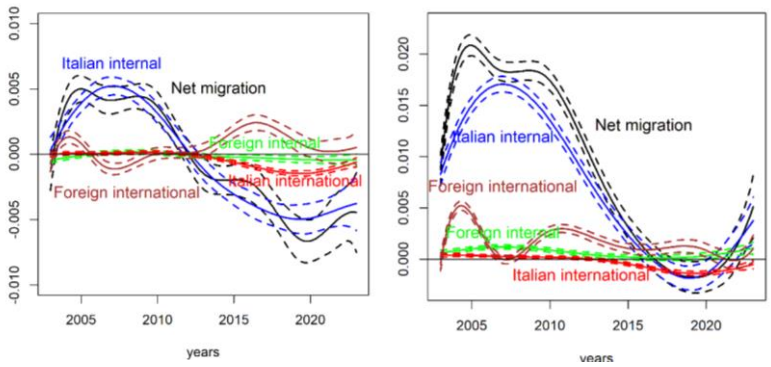
This sensitivity to model specification reflects the fact that migration responds strongly to local economic and territorial characteristics: areas with initially higher PSR values tend to attract working-age migrants, while peripheral and already aging areas continue to experience net outflows. For this reason, the conditional estimates provide a more informative assessment of migration's role, and from this point onwards, we focus on conditional results. The diverging impact of cohort turnover was strongest in the early 2000s, consistent with the younger age structure in the South. However, as the fertility advantage of the South waned, this effect weakened and by 2012–2023 was only visible in Bolzano and a few southern municipalities (Figure A3.6, panel b). Migration, on the other hand, generated strong divergence in 2002–2012: municipalities with higher initial PSR values, such as Lombardy, Veneto, and Lazio's coastal areas, benefited from net inflows (Figure A3.6, panel c), while many southern municipalities experienced net outflows, which exacerbated aging. After 2012, the effect attenuated: inflows into prosperous municipalities became less pronounced, while outflows from the South persisted (Figure A3.6, panel d).

3.5.3 Migration decomposition

Finally, Figure 3.6 decomposes the migration effect into internal and international flows, by Italians and foreigners. The divergent impact of migration in the first decade, and its subsequent attenuation, is almost entirely explained by the internal migration of Italians (blue line; see also Figure A3.9, panels a–b). International migration of foreigners (brown line) was more erratic but also contributed to divergence (Figure A3.9, panels c–d). Other components,

internal migration of foreigners and international migration of Italians, had negligible effects.

Figure 3.6 - Decomposing the net-migration effect



(a) Absolute convergence (b) Conditional convergence

Source: Our elaborations on Istat data.

Overall, these results confirm that while old-age dynamics are the main driver of convergence in aging across Italian municipalities, migration continues to shape spatial heterogeneity. Internal migration of Italians, in particular, has reinforced territorial imbalances, contributing to demographic fragility in peripheral areas and rejuvenation in urban centers.

3.6 Conclusions and policy implications

Italy faces a profound demographic challenge, with one of the fastest-aging populations worldwide, ranking just behind Japan and Korea. Declining fertility, rising life expectancy, and regional disparities have reduced spatial heterogeneity in municipal age structures, producing convergence toward an undesirable equilibrium in the Potential Support Ratio (PSR). This places increasing pressure on the working-age population to sustain the elderly.

Using a variable-coefficient beta convergence approach on municipality-level data (2002–2023), we find an accelerated convergence in the past decade, mainly driven by the elderly (65+) in the South, while the initially divergent effect of the working-age group (15–64) has faded. Net migration mainly works as a diverging force.

Migration is therefore crucial to mitigating aging in Italy, where fertility and mortality changes require decades to alter age structures. Yet migration alone cannot provide a durable solution and must be paired with policies that increase fertility and improve the quality of life for older adults. More effective immigration policies could help sustain the PSR, though political

resistance limits their scope. The *Decreto Flussi* has admitted about 800,000 workers in the past two decades, mainly in construction, agriculture, and care services, but such measures address only immediate shortages. Long-term strategies require integration policies that enhance language skills, economic participation, cultural assimilation, and family reunification.

Immigrants also contribute through higher fertility: in 2023, foreign women averaged 1.79 children versus 1.14 among Italians. This underlines the need for comprehensive family policies. Recent innovations, such as the *Assegno Unico Universale* and expanded childcare, represent progress but remain uneven across regions. Evidence shows that single measures have only modest, short-lived effects (Gauthier, 2007; Guetto et al., 2023), while coherent mixes of financial incentives, childcare, and parental leave yield more lasting impacts.

Beyond fertility, strategies must target working-age cohorts and promote active aging to transform older populations into social and economic resources. Disease prevention, incentives for firms to retain older workers, and digital literacy programs can reduce welfare costs and enhance participation.

While national-level interventions are crucial, our spatial analysis underscores the importance of place-based policies tailored to local contexts. Some regions, such as Liguria and Low Piedmont, entered the sample period with low PSR values due to deindustrialization in the 1970s. Others, despite starting from stronger positions, have since converged to the undesirable equilibrium because of weak cohort turnover or persistent outmigration. By contrast, areas benefiting from internal and international immigration of working-age individuals have sustained relatively higher PSR levels. Addressing such heterogeneity requires aligning demographic policies with the specific needs and economic profiles of different territories.

This is particularly urgent in peripheral areas experiencing the continuous outmigration of young, often highly educated individuals. Investment in infrastructure, community development, and support for small and medium-sized enterprises can foster growth and counter population decline. In this vein, the National Strategy for Inner Areas seeks to improve access to essential services, healthcare, education, and mobility, while promoting economic and social development through integrated, place-based initiatives. Covering 72 pilot areas, the strategy aims to enhance innovation, strengthen local skills, and improve quality of life in rural and remote communities. Within this framework, policies to retain skilled workers and

encourage the return of expatriates are critical, including tax incentives, career opportunities, and reintegration support (Coppola and Di Iorio, 2013).

Finally, intergenerational imbalances, socio-economic inequalities, and demographic decline are also reshaping metropolitan realities, producing peri-urbanization and segregation dynamics. The former reflects the outward expansion of households and firms into suburban or rural zones in response to housing affordability, while the latter manifests in uneven spatial distributions of population by socio-economic and cultural characteristics. Italian metropolitan areas are responding with policies of urban regeneration, redeveloping suburbs to foster integration and attract investment, and measures for social inclusion. Such interventions are essential to reduce center–periphery disparities and promote cohesive, sustainable urban development.

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A3. ANNEX

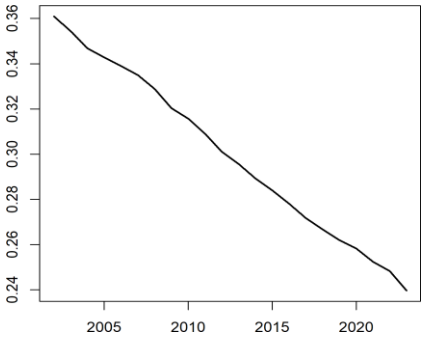
Table A3.1 - Summary statistics for the PSR

	Min	First quartile	Median	Mean	Third quartile	Max
2002	56.600	255.600	324.700	340.500	409.100	1220.100
2003	61.540	253.740	320.710	335.770	402.800	1196.390
2004	57.890	253.040	317.930	332.870	396.420	1162.810
2005	59.260	249.690	312.740	326.740	387.490	1323.530
2006	56.000	246.600	308.100	320.900	379.200	1666.700
2007	55.260	245.680	305.490	317.260	374.010	1805.000
2008	56.340	247.140	305.280	316.850	371.520	2009.520
2009	53.450	247.640	304.480	315.340	369.090	1688.460
2010	54.100	247.400	302.500	313.000	365.400	1715.400
2011	54.240	248.380	301.880	311.820	362.970	1470.970
2012	57.140	243.750	295.710	304.590	353.000	1285.710
2013	52.500	240.000	289.800	298.300	344.900	1340.000
2014	47.500	235.400	283.100	291.100	335.600	1217.900
2015	44.740	230.980	276.780	284.230	326.840	1205.130
2016	47.890	227.290	271.910	278.590	318.670	1109.300
2017	50.000	224.600	266.800	273.700	312.400	985.100
2018	48.080	221.970	262.400	269.590	307.790	883.020
2019	53.190	219.710	258.700	265.170	302.490	852.850
2020	58.140	215.930	253.150	259.480	295.520	832.020
2021	62.070	212.740	248.670	254.810	289.950	820.000

Table A3.2 - Summary statistics for the PSR

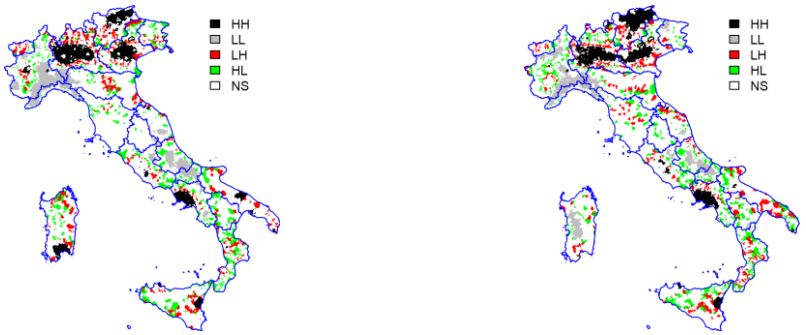
	Max-min	Inter-quartile range	Std. dev.	Coeff. of variation	Skewness	Kurtosis
2002	1163.448	153.487	122.857	0.361	1.069	5.810
2003	1134.848	149.059	118.999	0.354	1.022	5.536
2004	1104.911	143.374	115.439	0.347	1.002	5.406
2005	1264.270	137.804	112.017	0.343	1.063	6.024
2006	1610.667	132.655	108.768	0.339	1.193	8.111
2007	1749.737	128.330	106.285	0.335	1.287	9.973
2008	1953.186	124.372	104.183	0.329	1.462	13.921
2009	1635.013	121.450	101.036	0.320	1.244	9.562
2010	1661.286	117.967	98.844	0.316	1.308	10.559
2011	1416.730	114.595	96.391	0.309	1.167	8.175
2012	1228.571	109.248	91.737	0.301	1.075	7.080
2013	1287.500	104.921	88.217	0.296	1.109	7.832
2014	1170.449	100.222	84.209	0.289	1.088	7.417
2015	1160.391	95.861	80.741	0.284	1.081	7.633
2016	1061.415	91.383	77.496	0.278	1.061	7.290
2017	935.106	87.742	74.381	0.272	0.995	6.546
2018	834.942	85.828	71.923	0.267	0.943	6.131
2019	799.656	82.777	69.489	0.262	0.889	5.847
2020	773.881	79.595	67.024	0.258	0.865	5.879
2021	757.931	77.208	64.326	0.252	0.817	5.579

Figure A3.1 - Sigma convergence



Source: Our elaborations on Istat data.

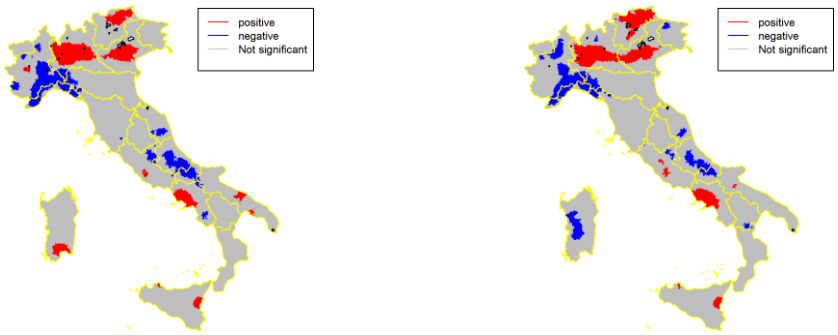
Figure A3.2 - Local Moran I statistics



(a) 2002 (b) 2023

Source: Our elaborations on Istat data.

Figure A3.3 - Local G statistics



(a) 2002 (b) 2023

Source: Our elaborations on Istat data.

PSR change and its components

Figures A3.4-A3.10 provide a comprehensive view of the spatial distribution and temporal dynamics of changes in the Population Stability Ratio (PSR) and its components over two distinct subperiods: 2002-2011 and 2012-2023.

Panels a) and c) in Figure A3.4 illustrate the initial PSR values for each subperiod. Coastal areas in the South, along with Lombardy, Veneto, and the province of Bolzano, exhibit higher PSR values at the beginning of both periods, indicating a relatively younger and more stable population base. Panels b) and d) highlight the changes in PSR, with notable negative shifts observed particularly in regions with initially high PSR values. The second subperiod (2012-2023) shows a more severe decline in PSR, especially in southern Italy and some central coastal areas, reflecting intensified demographic challenges. In contrast, some municipalities in the Center and select regions in Sicily and Calabria exhibit either slightly positive or less negative PSR variations during the first subperiod (panel b), suggesting relative demographic resilience in these areas.

Panels a) and b) in Figure A3.5 depict the changes in PSR attributable to the old-age component. The patterns closely mirror the overall PSR trends, underscoring the significant impact of an aging population on PSR decline in both subperiods. Areas with higher initial PSR values experienced negative changes due to the increasing proportion of elderly individuals, starting from 2002-2011. This trend is exacerbated in 2012-2023, particularly in southern regions, where the rise in the elderly population has intensified the overall decline in PSR. Panels c) and d) focus on the contribution of the working-age population to PSR changes. During the first subperiod, the working-age component mitigated PSR decline, particularly in areas with higher initial PSR values. However, the second subperiod (2012-2023) reveals a general worsening of the situation, especially in southern Italy, indicating that the previously positive correlation between working-age population dynamics and initial PSR values has diminished.

Panels a) and b) in Figure A3.6 emphasize the positive influence of the cohort turnover component on PSR dynamics, particularly evident in southern Italy during 2002-2011. The presence of a robust cohort turnover and youthful population in these areas initially supported PSR stability. Nonetheless, by 2012-2023, the impact of cohort turnover diminished, reflecting an overall aging population and declining birth rates, with particularly pronounced effects in the

South. Panels c) and d) illustrate the role of net migration, which had a beneficial effect on the working-age population during the first subperiod, especially in regions with initially high PSR values. Northern regions, Lazio, and some coastal southern areas experienced positive migration flows that counterbalanced aging trends. Conversely, the second period saw a predominance of negative migration balances in most southern areas, exacerbating the decline in the working-age population.

Panels a) and b) in Figure A3.7 demonstrate that internal migration patterns generally benefited northern areas, such as Lombardy and Emilia-Romagna, helping to alleviate PSR decline. In contrast, the South experienced a negative internal migration balance, a trend that intensified in 2012-2023. Panels c) and d) reveal that international migration has significantly impacted northern Italy, with a noticeable positive migration balance in the South during the second period partially offsetting the effects of aging and internal outmigration.

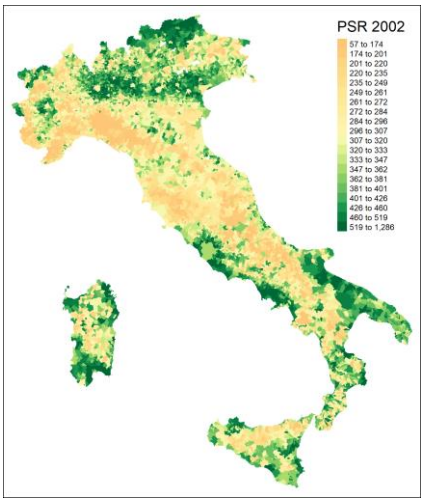
Panels a) and b) in Figure A3.8 highlight the persistent outflow of Italian citizens from south- ern to northern areas. Coastal southern regions showed a positive migration balance in the first subperiod, but the second subperiod saw a marked deterioration, particularly in Apulia, Calabria, and some northern areas like Bolzano. Panels c) and d) illustrate the increasing contribution of foreign migration to working-age population growth, especially in northern and central Italy. This positive effect of foreign migration became more significant in 2012-2023, helping to mitigate demographic decline in the South.

Panels a) and b) in Figure A3.9 underscore the trend of Italians moving towards economically vibrant regions, such as Rome and northern industrial centers, with a worsening internal migration balance in the South during 2012-2023. Panels c) and d) confirm that foreign internal migrants are increasingly settling in economically advantageous areas, particularly in the North. This trend is more pronounced in the second period, with foreign migrants increasingly favoring northern regions from southern areas.

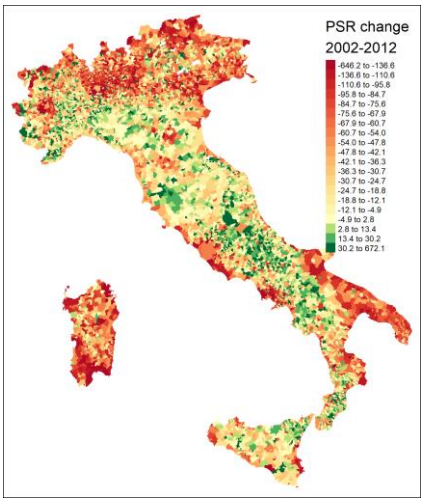
Panels a) and b) in Figure A3.10 highlight the significant variation in Italian international migration during the first subperiod, with negative balances observed in Bolzano and several southern areas. This trend worsens in the second subperiod (2012-2023), reflecting a generalized negative balance across most regions. Panels c) and d) emphasize the crucial role of foreign international migration in offsetting population decline, particularly in northern Italy. The impact of foreign immigration

becomes increasingly substantial in the second period, underscoring the growing reliance on international migrants to maintain demographic stability, even in the South.

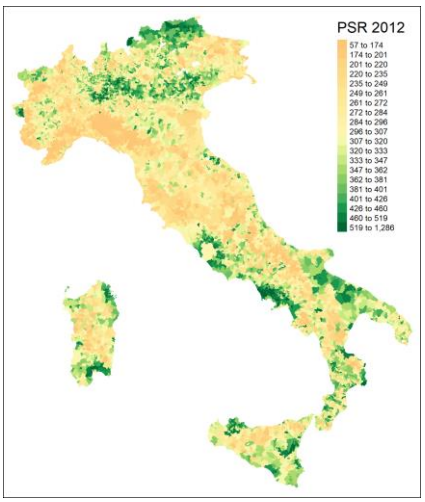
Figure A3.4 - PSR Initial Conditions and PSR Change



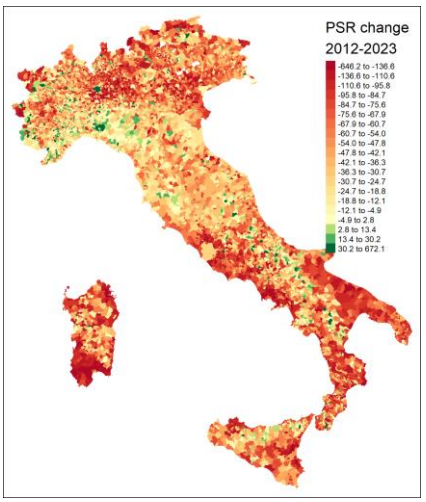
(a) PSR 2002



(b) PSR Change 2002-2012



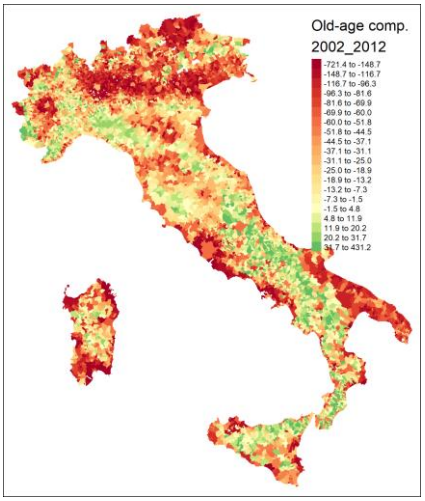
(c) PSR 2012



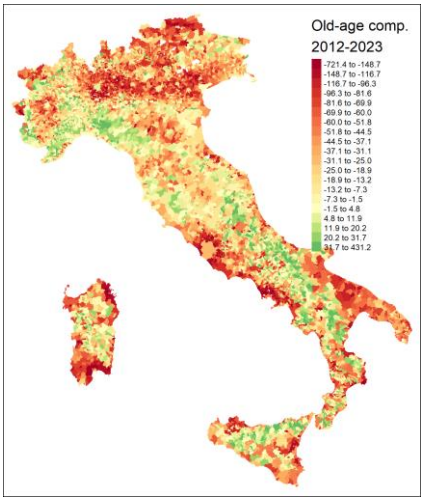
(d) PSR Change 2012-2023

Source: Our elaborations on Istat data.

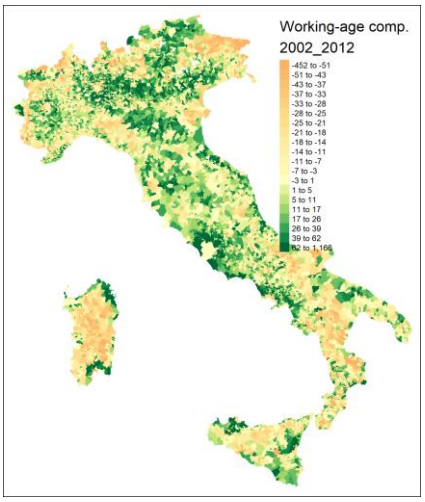
Figure A3.5 - Old-Age and Working-Age Components



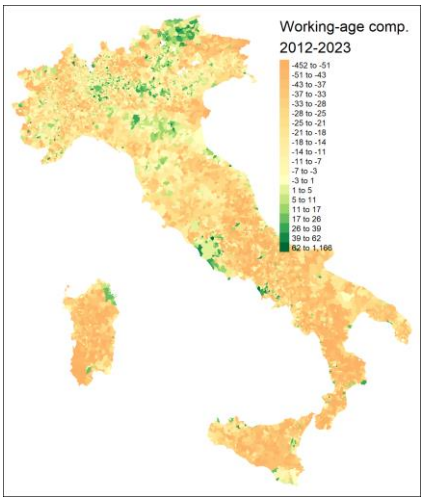
(a) Old Age 2002-2011



(b) Old Age 2012-2023



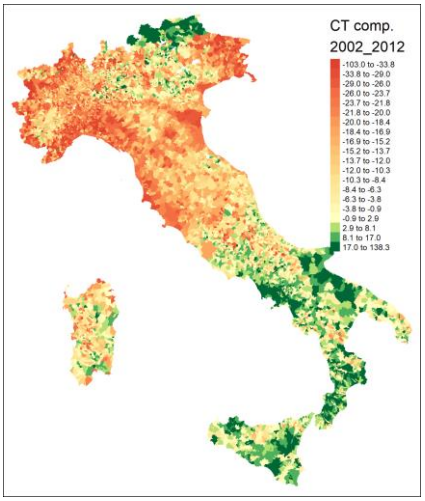
(c) Working Age 2002-2011



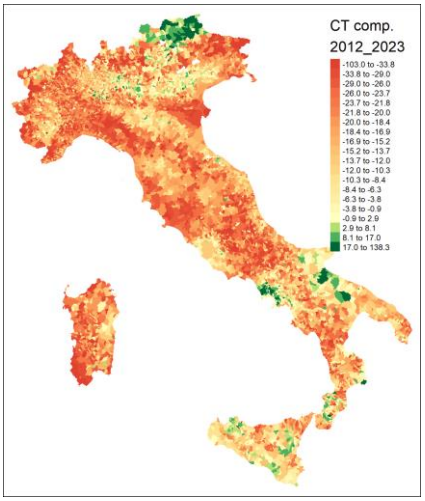
(d) Working Age 2012-2023

Source: Our elaborations on Istat data.

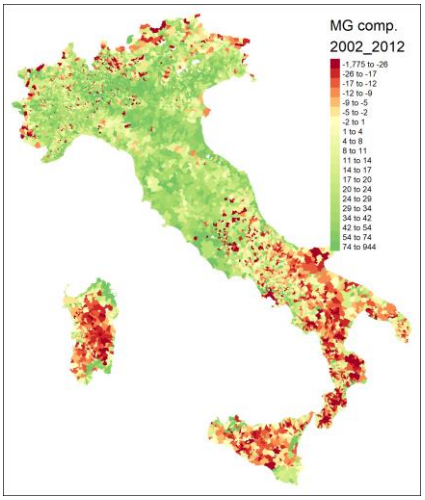
Figure A3.6 - Cohort Turnover and Migration Components



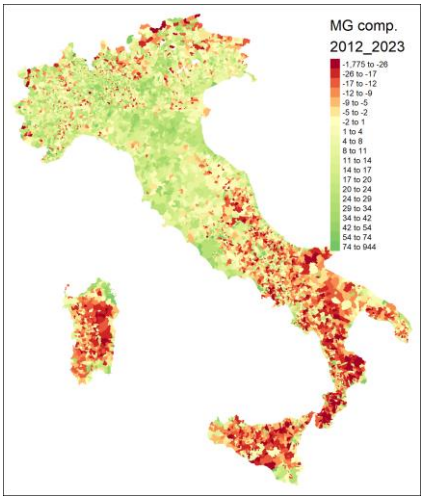
(a) Cohort Turnover 2002-2011



(b) Cohort Turnover 2012-2023



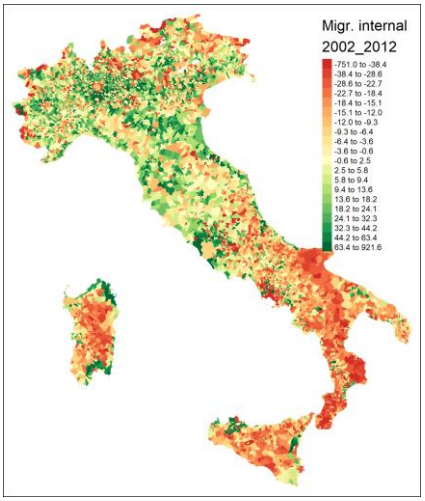
(c) Migration 2002-2011



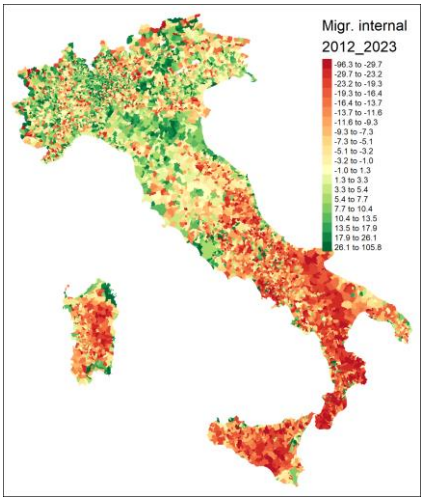
(d) Migration 2012-2023

Source: Our elaborations on Istat data.

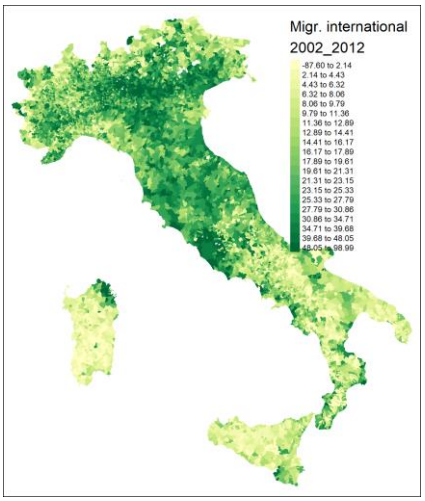
Figure A3.7 - Internal and International Migration Components



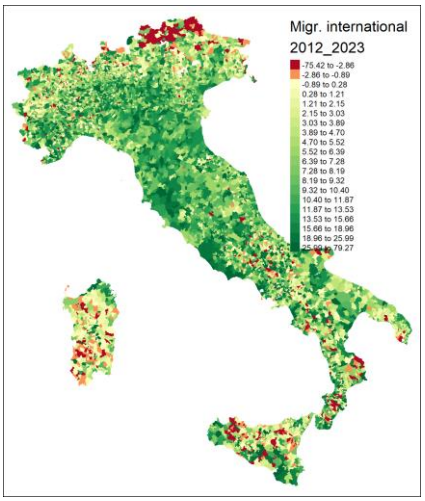
(a) Internal Migration 2002-2011



(b) Internal Migration 2012-2023



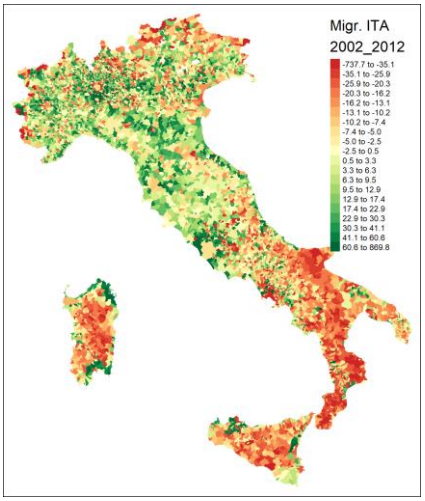
(c) International Migration 2002-2011



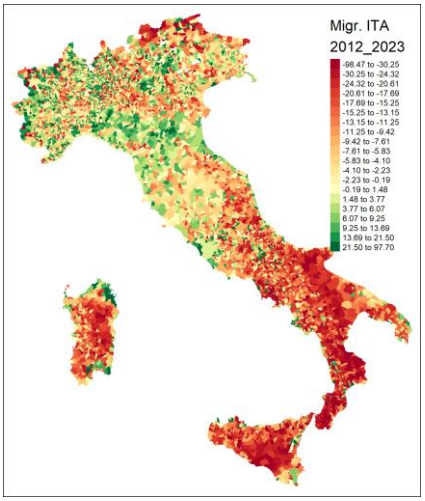
(d) International Migration 2012-2023

Source: Our elaborations on Istat data.

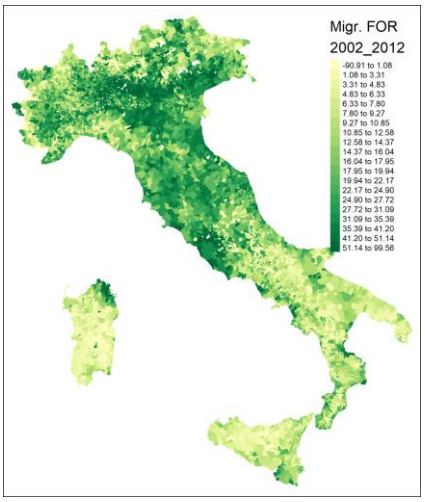
Figure A3.8 - Italian and Foreign Migration Components



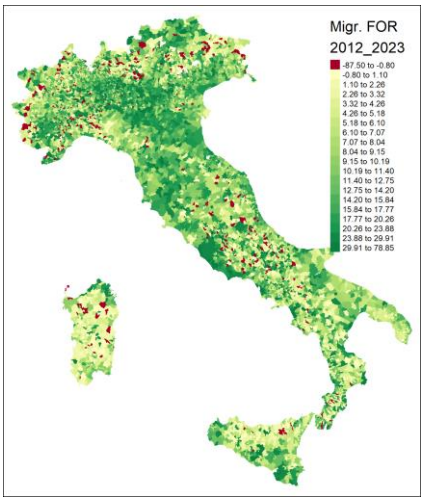
(a) Italian Migration 2002-2011



(b) Italian Migration 2012-2023



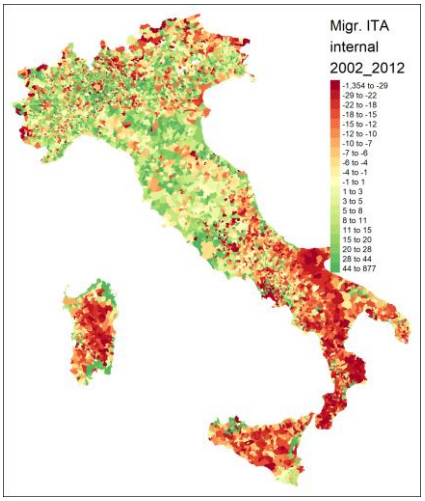
(c) Foreign Migration 2002-2011



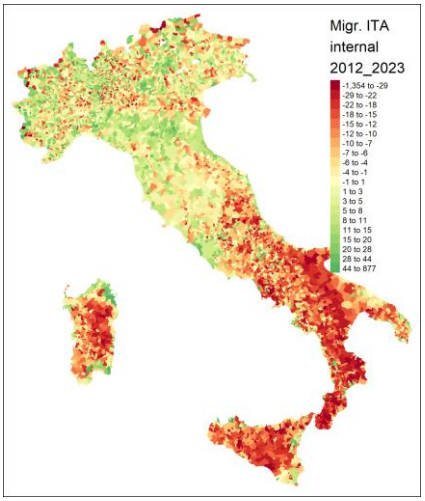
(d) Foreign Migration 2012-2023

Source: Our elaborations on Istat data.

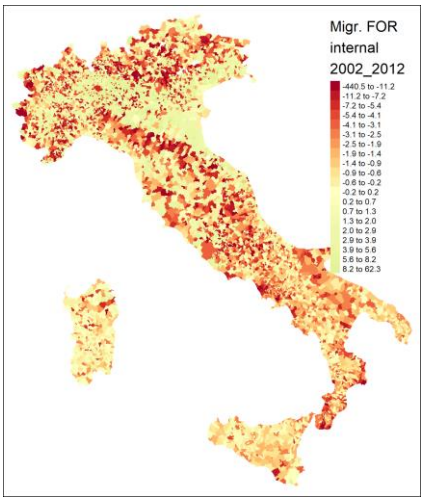
Figure A3.9 - Italian and Foreign Internal Migration Components



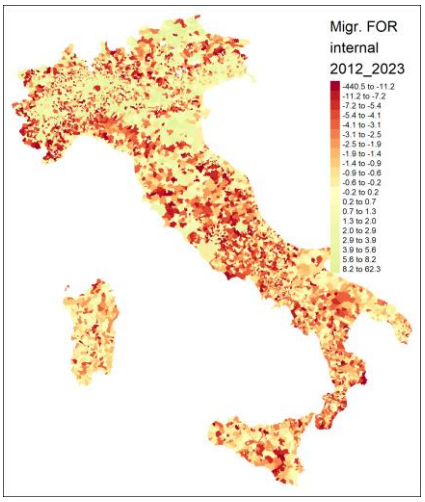
(a) Italian Internal Migration 2002-2011



(b) Italian Internal Migration 2012-2023



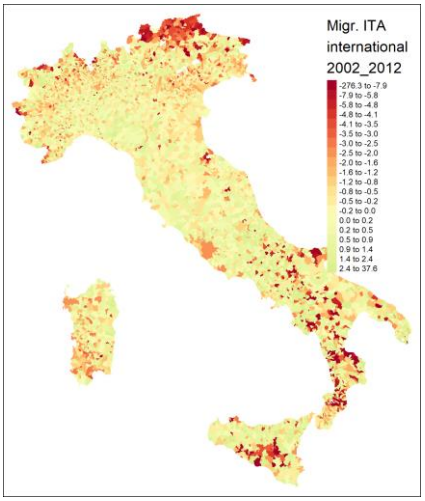
(c) Foreign Internal Migration 2002-2011



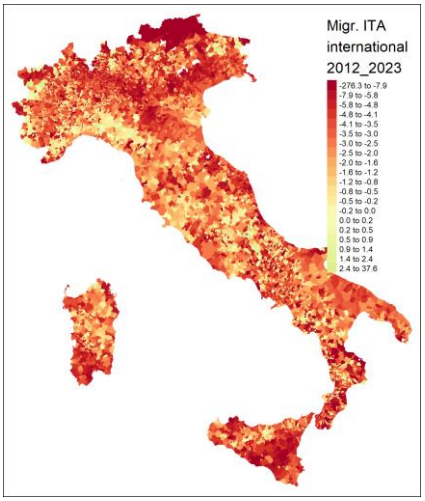
(d) Foreign Internal Migration 2012-2023

Source: Our elaborations on Istat data.

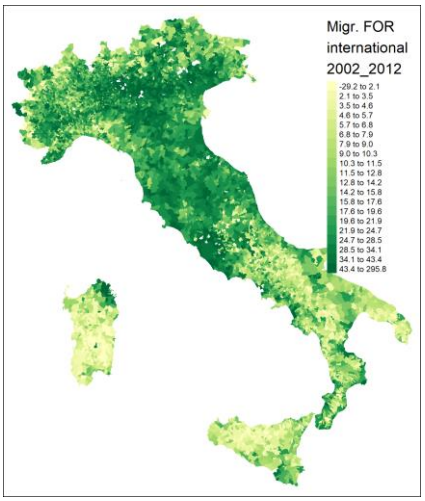
Figure A3.10 - Italian and Foreign International Migration Components



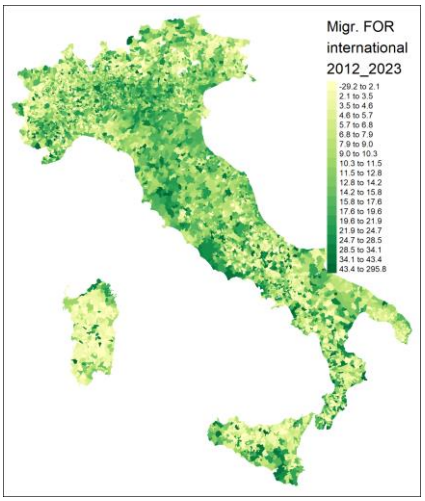
(a) Italian International Migration 2002-2011



(b) Italian International Migration 2012-2023



(c) Foreign International Migration 2002-2011



(d) Foreign International Migration 2012-2023

Source: Our elaborations on Istat data.

Chapter 4. Measuring brain drain in Italy: net migration flows and the North–South divide

Francesca Licari, Elena Ambrosetti[25], Roberto Basile, Cinzia Castagnaro

Abstract

Graduate emigration can be beneficial when temporary and skill-building, but when it becomes persistent it signals structural weaknesses in career opportunities in the country of origin. Amplified by Europe's demographic decline, the outflow of highly qualified youth leads demographic and economic losses. This is particularly true for Italy, one of the most affected countries, and which is also facing an internal brain drain driven by the North–South divide (hereafter, "South" refers to Southern Italy and the Islands, and North to the Center-North regions). This paper draws inspiration from Becker et al. (2004) to measure the brain drain in Italy, with a detailed set of indicators. In addition to previous studies, we also consider return migration of Italians, computing the brain drain as the difference between the brain drain and the brain gain due to emigration and immigration of highly educated young Italian people (25-34 years old). Moreover, we examine the compensatory effect between international and internal migration, particularly the migration of high-skilled Italian workers from the South to the North of Italy, highlighting the disproportionate human capital loss in southern regions. Finally, we exploit new data on the educational attainment of foreign immigrants, assessing their contribution to the dynamics of human capital at both national and regional level.

Keywords: Brain drain, net migration, circular migration.

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4.1 Introduction

The emigration of tertiary-educated workers can, in some cases, serve as a transitional phase of career enhancement and skill acquisition: exposure to diverse research and production environments, frontier technologies, and international networks may translate, upon return, into productivity gains, knowledge diffusion, and stronger innovative capacity at origin. Beyond individual human capital, temporary and circular mobility can seed diaspora externalities (mentoring ties, collaborative projects, co-inventorship and co-authorship networks) that continue to generate spillovers even before physical return (Saxenian, 2005; Agrawal et al., 2011). The magnitude of these gains, however, depends crucially on absorptive capacity of the origin economy, that is, its ability to recognize, assimilate, and exploit new external knowledge (Cohen and Levinthal, 1990; Docquier and Rapoport, 2012).

When such mobility is temporary or circular, it can facilitate cross-border knowledge transfer and raise the competitiveness of domestic firms and institutions. Two channels are often salient. First, relational channels, whereby returnees and non-returning diasporas reduce search and contracting frictions for trade, FDI, and collaborative research. Second, organizational channels, whereby returnees import routines (quality standards, data practices, open-science norms) that diffuse within teams, often yielding productivity gains disproportionate to the headcount involved. These effects are strongest in skill- and knowledge-intensive sectors and in regions where complementary inputs are in place (Kerr et al., 2016; Bahar and Rapoport, 2018).

By contrast, when highly skilled emigration becomes persistent and is not offset by commensurate inflows or returns, countries face a loss of talent and an erosion of public and private investment in human capital. The withdrawal of young, highly educated workers, especially from skill-intensive sectors that underpin long-run growth, can depress innovation, research output, and economic resilience (Beine et al., 2001; Schaeffer, 2005; Straubhaar, 2000). Importantly, losses are non-linear: once the local stock of specialized skills falls below certain thresholds, ecosystems can unravel, graduate training becomes less attractive, academic departments struggle to maintain programs, and firms curtail high-value functions. Such threshold dynamics are consistent with agglomeration and capability-complementarity mechanisms (Moretti, 2012; Duranton and Puga, 2004; Hidalgo and Hausmann, 2009), implying that identical outflow rates can have much larger consequences in smaller or already fragile regions (Atoyan et al., 2016).

Two further asymmetries matter for long-run outcomes. Selection asymmetry occurs when emigrants are positively selected on ability and field (e.g., STEM PhDs), while inflows are concentrated in different skills or are underemployed due to credentialing barriers; this constrains the compensatory role of immigration even when headcounts look balanced (Docquier and Rapoport, 2012). Timing asymmetry arises when emigration is rapid while return or compensating inflows are slow, widening temporary but economically meaningful gaps in teaching capacity, supervision of junior researchers, and firm-level innovation cycles. These asymmetries are amplified by institutional frictions that discourage both return and effective

integration of high-skill immigrants (Czaika and Parsons, 2017).

These challenges are amplified by Europe's demographic headwinds. The European Commission (2023) identifies a set of regions caught in a "talent development trap", characterized by a shrinking working-age population, low tertiary attainment, net youth outflows, and weak growth in graduates (four-indicator framework). Several Member States in Central and Eastern Europe are particularly affected, while exposure varies widely across Western and Southern Europe. In comparative perspective, Italy's tertiary attainment among 25–64-year-olds remains below the EU leaders, and a large subset of Italian regions combine demographic decline with insufficient graduation rates. According to the Commission's mapping, 46 European regions fall into the talent-trap category, including, within Italy, Piedmont, Liguria, Valle d'Aosta, Friuli-Venezia Giulia, Marche, Umbria, Abruzzo, Sardinia, Sicily, Calabria, Apulia, Basilicata, and Molise (European Commission, 2023). Demography and brain drain interact in feedback loops: shrinking cohorts reduce university demand and local fiscal capacity, which in turn weakens the supply of high-skill jobs and research opportunities, further incentivizing outmigration. Conversely, regions that attract or retain even modest numbers of young graduates can tip into virtuous cycles (denser networks, thicker labor markets, and higher innovation intensity).

Internal movements are also important, especially in countries like Italy characterized by a strong dualism between northern and southern regions. The "Southern Question" refers to a long-standing set of economic and social disparities that have shaped the marginalization of the South since national unification, affecting economic development, employment, infrastructure, and access to public services. Despite repeated policy interventions, most notably the establishment of the *Cassa per il Mezzogiorno*[26] in 1950, these gaps have proven persistent (Daniele and Malanima, 2011).

In recent decades, sustained migration toward the Center–North and abroad has increasingly involved young and often highly educated individuals seeking better educational and professional opportunities. As a result, alongside international brain drain, Italy also experiences a persistent internal brain drain that reallocates young population and human capital away from southern regions, with potentially long-lasting implications for regional divergence (SVIMEZ, 2024; ISTAT, 2025).

A final consideration is the changing nature of mobility. Remote and hybrid work, international doctoral training, and short, intensive research visits blur the line between "stay" and "move," expanding the scope for brain circulation. These modalities can mitigate losses if origin institutions reduce participation costs (micro-grants for short stays, visiting appointments, co-supervision schemes) and if immigration regimes enable complementary inflows in scarce profiles. Without such complementary policies circulation benefits remain thin, while the costs of persistent outflows accumulate.

[26] The *Cassa per il Mezzogiorno* (Fund for the South) was established by Law No. 646 of 10 August 1950 as a public body tasked with financing and implementing extraordinary interventions for the economic and social development of Southern Italy. After several extensions, it was abolished and placed under liquidation in 1984.

Building on Becker et al. (2004), and motivated by the international and internal dimensions outlined above, we assess Italy's net loss of human capital using a set of indicators and focusing on young adults aged 25–34. Departing from prior studies, we compute net brain drain as the difference between outflows and inflows of highly educated youth, integrating return and immigration dynamics into the aggregate balance. We also examine substitution and reinforcement between international and internal migration, with particular attention to movements of highly educated workers from the South to the North and the resulting disproportionate depletion in Southern regions. Our research questions are: *i*) How large is Italy's brain drain once returns of Italian citizens are incorporated? *ii*) Does internal movement of human capital act as a compensatory force or as a secondary channel of loss? *iii*) Do foreign graduates arriving in Italy offset skill losses or do they differ so much in profile that substitution is limited?

The paper is organized as follows. Section 4.2 provides a theoretical framework on brain drain; Section 4.3 describes data and methods for measuring brain drain; Section 4.4 presents stylized facts; Section 4.5 reports the results; Section 4.6 concludes the study.

4.2 Theoretical framework

The debate on the economic and demographic consequences of brain drain has a long tradition. Early theoretical contributions stressed the negative implications of skilled emigration, viewing it as a permanent loss of human capital and a waste of national investments in education (Grubel and Scott, 1966; Johnson, 1967; Bhagwati and Hamada, 1974). These works emphasized how the departure of highly educated individuals could erode a country's innovative capacity and growth potential, particularly when not compensated for adequate inflows of similarly skilled migrants. More recent theory shows that, under specific conditions, the prospect of emigration can induce additional human-capital formation (*beneficial brain drain*) (Mountford, 1997). The decision to settle abroad often reflects structural constraints at origin, limited career opportunities, macroeconomic instability, and weak incentives for high-skill employment, highlighting the need for policies that retain and attract talent (Kuznetsov, 2006).

The *Human Capital Theory* posits that individuals' knowledge, skills, education, and health constitute a form of capital that enhances their productivity and economic value. Originating from the works of Schultz and Becker in the 1960s, the theory conceptualizes education and training as purposeful investments, analogous to investments in physical capital, that yield returns in the form of higher wages and improved economic outcomes. Mincer (1974) later formalized the empirical link between schooling, work experience, and earnings through the Mincer earnings function. According to this theory, human capital, together with physical capital and technology, shapes productivity and output (Lucas, 1988). In neoclassical growth models, per-capita income reflects the per-capita endowment of these factors; therefore, more human capital per worker implies higher income per worker (Solow, 1956; Mankiw et al., 1992). Jones (2002) highlights that rising educational attainment and research intensity have supported post-war U.S. growth within an ideas-driven framework.

Applied to migration, selective emigration of educated individuals reduces average human capital ("brain drain") and can lower levels and/or slow rates of growth; conversely, skilled immigration raises them ("brain gain") and can increase productivity and incomes (Docquier and Rapoport, 2012; Beine et al., 2008; Peri, 2007). The net effect depends on: (i) selectivity by education/experience (Borjas, 1987; Chiquiar and Hanson, 2005); (ii) complementarity with capital and technology, including innovation and patents (Hunt and Gauthier-Loiselle, 2010); and (iii) matching between incoming skills and sectoral needs (Card, 2001; Dustmann et al., 2013). Short- and long-term dynamics may diverge: in the short run, emigration can ease local excess labor supply, whereas over the long run it can weaken high-skill ecosystems; skilled immigration can generate agglomeration and knowledge-diffusion externalities.

An additional layer of selectivity concerns the field of study. Skilled outflows concentrated in STEM/ICT and in regulated professions may have disproportionate consequences for innovation, productivity, and the functioning of local knowledge ecosystems, while mobility in other fields may imply different opportunity costs and different return dynamics. Evidence shows that losses of scientists, engineers, and ICT specialists are more tightly linked to declines in patenting, R&D intensity, and firm-level innovation than equally sized outflows in other disciplines (Kerr et al., 2016). Field-specific selectivity therefore matters not only for the magnitude of human-capital losses, but also for their qualitative and long-run economic implications.

The definition of brain drain has evolved over time. In its narrow sense, it denotes the permanent outflow of highly skilled individuals. Subsequent research has broadened the concept of distinguishing temporary vs. permanent and return vs. circular mobility, and arguing for tracking not only gross outflows but also net balances of human capital. Correspondingly, measurement strategies have diversified. Classic indicators track the share of tertiary-educated emigrants relative to the origin country's educated population (Docquier and Marfouk, 2006). Alternative approaches compare the educational composition of emigrants and stayers, use corrected skilled-emigration rates that account for age at entering destination countries (Beine et al., 2008) and draw on updated datasets building on Docquier and Marfouk (2006).

Over time, literature has adopted more nuanced perspectives. A sizeable strand highlights "beneficial brain drain" channels: migration can generate positive externalities for origin countries via remittances, knowledge diffusion, diaspora networks, and the eventual return of skilled workers; moreover, expected migration prospects can raise incentives to invest in education when foreign–domestic wage differentials are salient (Mountford, 1997; Stark et al., 1997; Vidal, 1998; Beine et al., 2008; Straubhaar, 2000; Giannoccolo, 2009). This has spurred methods that jointly consider brain drain and brain gain, and attempts to measure brain circulation (Kuznetsov, 2006; Saxenian, 2005), emphasizing that mobility is not one-way and that outcomes reflect the balance among outflows, inflows, and returns.

At the empirical level, contributions examine both international and internal dimensions. Within Europe,

growing attention is paid to demographic decline, regional disparities, and structural labor-market weaknesses as push factors for graduate emigration (Milio et al., 2012; Kooiman et al., 2018). Evidence shows that peripheral and less-developed regions are disproportionately affected by graduate outflows, whereas more dynamic hubs concentrate human capital. From a brain-circulation perspective, temporary or circular mobility can be beneficial, fostering knowledge transfer upon return and via diaspora linkages, while persistent outflows unaccompanied by similarly skilled inflows produce net losses that weaken innovation and long-run growth. Europe's demographic headwinds magnify these effects: recent EU assessments identify many regions, Italy among the most affected, with shrinking working-age populations, low tertiary attainment, and net youth outflows (European Commission, 2023; Eurostat, 2024).

Immigration thus emerges as a key component of the overall human-capital balance. Studies on the United States and other advanced economies highlight the decisive contribution of foreign graduates and professionals to R&D and patenting, often cushioning losses from native outflows (Hunt and Gauthier-Loiselle, 2010). At the European level, immigration can play a compensatory role, though with large cross-country differences depending on the selectivity of inflows (Docquier and Rapoport, 2012). In countries like Italy, earlier evidence documented sizeable graduate outflows in the late 1990s, limiting compensation at the time (Becker et al., 2004). More recent inflows indicate gradual improvements in immigrants' educational attainment, suggesting growing potential contributions, while standard indicators often under-capture return migration and lack the regional granularity needed to assess how immigration reshapes the geography of human capital (OECD, 2024).

In the Italian case, several studies document a persistent internal brain drain from the South to the North alongside significant international emigration of graduates (Mocetti and Porello, 2010; Ciriaci, 2013). This dual phenomenon raises concerns about cumulative divergence, whereby the South is doubly penalized: by the loss of young talent abroad and by the North's attraction power. Yet most measures rarely integrate return migration and only partially account for the contribution of foreign immigrants to regional human-capital balances.

The paper integrates these perspectives in two ways. First, it explicitly accounts for return migration in measuring brain drain among young Italians (25–34). Second, it leverages new data on the educational attainment of foreign immigrants to evaluate whether immigration compensates or reinforces human-capital losses at national and subnational levels.

Building on Becker et al. (2004), we construct a set of indicators to assess Italy's net loss of human capital as the difference between outflows and inflows of highly educated youth, integrating return and immigration dynamics. We also examine substitution vs. reinforcement between international and internal migration, with particular attention to South-to-North movements and their disproportionate depletion effects in southern regions, and we discuss the policy implications of structural constraints that

motivate settling abroad, namely, the need for retention, attraction, and diaspora-engagement policies aligned with high-skill labor-market demand (Mountford, 1997; Kuznetsov, 2006).

4.3 Brain drain indicators and data

The analysis of the brain drain in Italy requires a robust quantitative approach, incorporating comprehensive, data-driven, insights which are essential for quantifying the phenomenon, as well as for understanding the demographic and socioeconomic characteristics of the affected population, their destinations, and the potential impacts on Italy's labor market and economic growth. The purpose of this paper is to evaluate the loss of human capital by employing standard indicators that have been previously proposed in the extant literature by Becker et al. (2004). Specifically, our analysis is founded on the Human Capital Theory, which considers human capital to be one of the three essential factors of production, along with physical capital and technology. From this perspective, emigration that reduces human capital per worker leads to lower or slower income growth, while immigration that increases human capital per worker leads to higher or faster income growth.

Let P_t denote the resident population at the beginning of the year t, and E_t and R_t the number of emigrants and immigrants during the year t, respectively. The data at our disposal allow us to distinguish the population and the migration flows according to the level of education pursued by individuals: a) up to the primary school leaving certificate, b) up to the middle school leaving certificate, c) up to the high school diploma, and d) up to the university degree or beyond. Considering that it takes on average 5 years of study to acquire the primary school leaving certificate, 8 for the middle school leaving certificate, 13 for the high school diploma, and 18 for the university degree, we have calculated the total number of years of education completed by the resident population at the beginning of the year t, H_t^P, the total years of education completed by the emigrants and immigrants H_t^E and H_t^R, respectively, during year t. The three ratios:

$$h_t^P = \frac{H_t^P}{P_t}, \qquad h_t^E = \frac{H_t^E}{E_t}, \qquad h_t^R = \frac{H_t^R}{R_t}$$

measure the average number of years of education completed by the population at the beginning of year t and by the emigrants and immigrants during year t, respectively. Finally, following the Mincerian approach according to which human capital is modeled as an exponential function of years of schooling, the indices:

$$\psi_t^E = e^{\beta(h_t^E - h_t^P)} \quad (1)$$

$$\psi_t^R = e^{\beta(h_t^R - h_t^P)} \quad (2)$$

measure the relative human capital per worker of emigrants and immigrants versus residents, respectively. The β parameter denotes the Mincerian *return to schooling*, i.e. the semi-elasticity of productivity with respect to an additional year of education. Following Becker et al. (2004), we set β=0.035, consistent with Italian estimates (≈5–7% in later studies), and check sensitivity across the 0.03–

0.07 range (see Table A4.1 Annex). If $\psi_t^E > 1$ then the average human capital of emigrants is larger than that of residents (the country loses human capital per worker as a result of emigration), and there is a reduction in productivity due to the decrease in human capital per worker in the economy. Conversely, if $\psi_t^R > 1$, immigrants have higher average human capital than residents, leading to a gain in human capital per worker and an increase in productivity.

In aggregate form, we define the following indices:

$$\Psi_t^E = 100\frac{E_t e^{\beta h_t^E}}{P_t e^{\beta h_t^P}} = \eta_t^E * \psi_t^E \quad \text{where } \eta_t^E = 100\frac{E_t}{P_t} \qquad (3)$$

$$\Psi_t^R = 100\frac{R_t e^{\beta h_t^R}}{P_t e^{\beta h_t^P}} = \eta_t^R * \psi_t^R \quad \text{where } \eta_t^R = 100\frac{R_t}{P_t} \qquad (4)$$

These indices vary between 0 and 100 and allow us to decompose changes in the aggregate human capital of net migrants(Ψ_t) into two components: changes due to the aggregate migration of workers (η_t) and changes due to the human capital content of migrants (ψ_t). Specifically, equation (3) measures the aggregate of human capital of emigrants ($E_t e^{\beta h_t^E}$) as a percentage of the aggregate human capital of the population ($P_t e^{\beta h_t^P}$). In other words, it measures the aggregate production loss caused by emigration. The term η_t^E measures the aggregate loss of pure labor due to emigration (i.e., emigration rate); equation (4) measures the aggregate human capital of immigrants ($R_t e^{\beta h_t^R}$) as a percentage of the aggregate human capital of the population ($P_t e^{\beta h_t^P}$). In other words, this reflects the aggregate production gain from immigration and the term η_t^R represents the pure labor gain from immigration (i.e. immigration rate). In essence, these indices quantify the impact of migration on productivity by considering both the number of migrants and their relative human capital.

Many economists argue that the emigration of college graduates is particular detrimental to a country's economy because they play a crucial role in research and innovation (Docquier and Rapoport, 2012; Beine, at al., 2008; Bhagwati and Hamada, 1974). College graduates are key drivers of the increasingly skill-biased technological progress and have managerial skills essential to use technology. To address this concern, it is useful to define specific indices that measure the loss of college graduates due to emigration, both on a "per worker" basis and on aggregate terms. These indices can provide a clearer understanding of the economic impact of the emigration of highly educated people:

$$\gamma_t^E = \frac{g_t^E}{g_t^P} \qquad (5)$$

$$\gamma_t^R = \frac{g_t^R}{g_t^P} \qquad (6)$$

where $g_t^P = \frac{G_t^P}{P_t}$, $g_t^E = \frac{G_t^E}{E_t}$, and $g_t^R = \frac{G_t^R}{R_t}$ are share of college graduates, respectively, in the residents population, and among emigrants and immigrants. If $\gamma_t^E > 1$, it implies that emigrants are disproportionately composed of university graduates relative to the resident population – suggesting a

loss of high-skilled labour. The same logic applies to $\gamma_t^R > 1$. The difference $\gamma_t^E - \gamma_t^R$ measures the net loss or gain in the share of college graduates per worker due to migration flows.

Similarly for the index (3) and (4), we also define the measure of the aggregate loss or gain of college graduates due to emigration/immigration:

$$\Gamma_t^E = 100\frac{G_t^E}{G_t^P} = \eta_t^E * \gamma_t^E \qquad (7)$$

$$\Gamma_t^R = 100\frac{G_t^R}{G_t^P} = \eta_t^R * \gamma_t^R \qquad (8)$$

which captures the aggregate skill content of migrants.

Finally, as a measure of net aggregate loss or gain of human capital in the economy, we consider the difference between (3) and (4) and between (7) and (8):

$$\Psi_t^E - \Psi_t^R = 100\frac{E_t e^{\beta h_t^E} - R_t e^{\beta h_t^R}}{P_t e^{\beta h_t^P}} \qquad (9)$$

$$\Gamma_t^E - \Gamma_t^R = 100\frac{G_t^E - G_t^R}{G_t^P} \qquad (10)$$

They measure the net aggregate loss (or gain) of human capital in the economy (9) and the aggregate loss (or gain) of college graduates due to migration (10), respectively. These indices can be either positive (where the aggregate human capital -or the aggregate of college graduates- of emigrants exceeds that of immigrants) or negative (whit immigrants contributing more human capital – or college graduates- than is lost through emigration), respectively in the case of loss or gain of human capital.

In this study, we firstly use the two pairs of indices to assess the net loss of human capital over the last decade (from 2013 to 2022) by considering the net migration abroad of young Italians (25-34 years old). Then, we consider the counteracting effect of internal migration from the South to the central and northern regions, which manages to compensate for the losses in the North and the Centre due to international migration, turning them into gains in human capital. Following this approach, we will evaluate the overall loss of human capital at the subnational level.

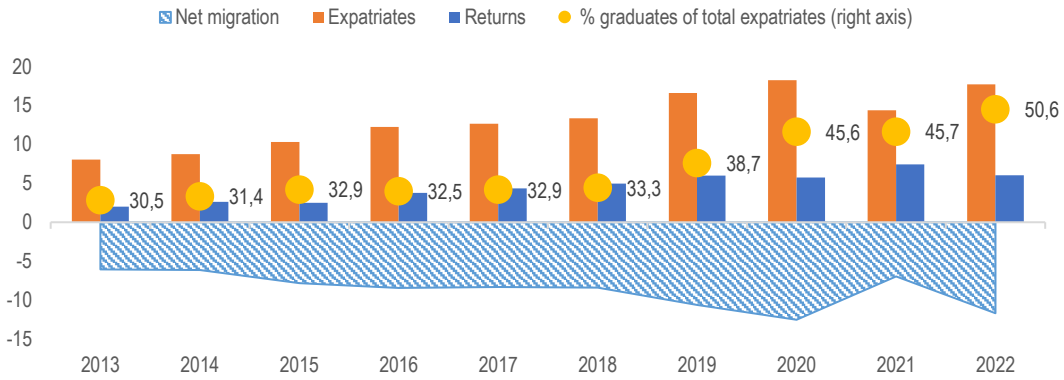
To carry out this analysis, we use official data based on changes in residence recorded in Municipality Population Registers. These data are collected at the municipality level by the Italian National Institute of Statistics (Istat). Individual data includes demographic information on migrants, such as age, educational attainment, and citizenship, as well as on the flows, such as country of origin and destination. For population estimates by educational attainment, we use data from the Labor Force Survey for the years up to 2017 and from the Permanent Census for the period 2018–2022. These sources allow us to consistently disaggregate both population stocks and migration flows by education level. In line with established practice in macroeconomics, we use years of schooling/educational attainment as a proxy for human capital (Hall and Jones, 1999; Barro and Lee, 2013; Mankiw et al., 1992), while acknowledging the limitations discussed by Krueger and Lindahl (2001) and Hanushek and Woessmann (2008).

4.4 Descriptive findings

According to the Italian National Institute of Statistics (Istat, 2024), in Italy, more than one million residents were expatriated in the decade 2013-2022, of which more than one-third (352,000) were young people aged 25-34. The impact of the emigration of young people is significant and complex, affecting both the demography and the economy of the territories. The demographic decline that has been affecting Italy for more than a decade due to an increasingly low and late fertility rate is partly attributed to the emigration of young people of reproductive age. When young migrants are highly qualified, the demographic loss is compounded by the economic loss of human capital.

Between 2013 and 2022, 132,000 Italian graduates aged 25-34 emigrated, while only 45,000 returned, resulting in a net loss of over 87,000 highly qualified young (Figure 4.1).

Figure 4.1 - Migration of Italian college graduates aged 25-34. Years 2013-2022, absolute values in thousands, and percentage values (right axes).



Source: Our elaborations on Istat data.

This increasing emigration trend is partially influenced by the Brexit effect. The United Kingdom, as the primary destination for skilled Italian emigrants, may have expedited the registration process in AIRE for those residing in the UK to secure their settled status. After the Brexit effect subsided and the pandemic shock lessened, emigration among young talent stabilized at slightly lower levels than those observed before the pandemic. Of those who emigrated over the decade, 22% held a bachelor's degree, 72% a master's degree, and 6% a postgraduate degree.

The favored destinations for college graduates were the United Kingdom (28,000 emigrants), Germany (18,000), Switzerland (12,000), France (11,000), and, among non-European destinations, the United States (7,000). Notably, they predominantly emigrated from Northern Italy (one in two), while only one in four graduates emigrated from Southern Italy. The North thus saw the most significant loss of human capital to emigration between 2013 and 2022, with a net balance of approximately -43,000, compared to -14,000 in the Center and -30,000 in the South.

Internal migration partially mitigates this scenario, sometimes reversing the negative balances and leading to population gains (Table 4.1). Specifically, the North attracted over 125,000 graduates from the

South and the Centre, balancing its emigration losses (-43,000) with a positive net gain of around 82,000. This allowed the northern regions to achieve a dual benefit: mitigating the "brain drain" effects of emigration and securing a substantial influx of human capital.

Table 4.1 - Net internal and international migration of college graduates aged 25-34, by micro areas. Years 2013-2022, absolute values.

Macro areas	Net internal	Net international	Net total
North-west	*81,951*	*-24,778*	*57,173*
North-East	*42,908*	*-18,112*	*24,796*
North	124,859	-42,890	81,969
Centre	13,125	-14,033	-908
South	*-101,248*	*-19,462*	*-120,710*
Islands	*-36,736*	*-10,671*	*-47,407*
South+Islands (*Mezzogiorno*)	- 137,984	-30,133	-168,117
Italy	-	-87,056	-87,056

Source: Our elaborations on Istat data.

The Centre also benefited from internal migration, drawing over 13,000 young graduates from the South and the North, and reducing its net loss to around 900. In contrast, the South experienced a double loss in emigration abroad and internal migration to the North and Centre. The South's loss of young graduates amounted to over 168,000, reflecting a demographic and intellectual imbalance that underscores the established trend where the more productive North and Centre increasingly attract young talent from the South. Consequently, the South remains in a structurally disadvantaged position, losing essential human capital for its development and further widening the gap with the economically more developed regions of the country.

4.5 Brain drain: evidence

4.5.1 International brain drain

Following Becker et al. (2004), we analyze the loss or gain of human capital associated with international mobility among Italians aged 25–34, over the last observed decade (2013-2022). We first calculate the ψ_t^E and ψ_t^R (respectively, the relative human capital per worker of expatriates and returns) (Figure 4.2). The trend of ψ_t^E shows a significant increase over the sample period, rising from 0.98 in 2013 to 1.03 in 2022. While from 2013 to 2018 the human capital of those leaving was lower than that of those staying, the index greater than 1 from 2019 onward indicates that the average human capital of emigrants is larger than those of the resident population.

On the other hand, over the same period, the ψ_t^R remained above 1 until 2020, suggesting that the human capital related productivity of Italian immigrants is larger than those of residents. Consequently, the indices reveal that, up to 2019, Italy benefited from the return of human capital from foreign countries, as it gained more productive workers than it lost. However, this trend reversed in the last three years, with Italy losing more productive human capital per worker than it gained. Crucially, ψ_t^N is the human-capital

index of *net migration*, it summarizes the per-worker quality of the *net* international flow once inflows (including returns) are balanced against outflows: it is negative up to 2019 (−0.036 in 2013; −0.006 in 2019), indicating a net gain, and turns positive from 2020, reaching 0.032 in 2022, signaling a net loss.

Focusing specifically on the expatriation of young college graduates during the period 2013-2023, the outcomes are particularly striking. The emigrant gamma values (γ_t^E), which measure the skill content per worker of emigrants relative to residents, consistently are greater than 1 throughout the period. This indicates that the share of young college graduates among emigrants has been higher than their share within the resident population. In contrast, the gamma values for Italian immigrant (γ_t^R) show a gradual decline over the same period. However, these values are positive and greater than 1 suggesting that, while diminishing, the skill content per worker of Italian returns are exceeding that of the residents. The net migration index γ_t^n shifts from −0.43 in 2013 to 0.30 in 2022, echoing the same deterioration (Table 4.2). In other words, these patterns indicate that since 2019 international outflows have become increasingly high-educated, while the quality premium of return migration has narrowed, since 2020 the net balance turns adverse for Italy's human capital.

The trend of $\boldsymbol{\psi}_t$ and $\boldsymbol{\gamma}_t$, are broadly similar across Italy's two macro-areas. The North (hereafter, "North" includes also central regions) shows a clear turning point in 2020, whereas in the South the reversal is anticipated by one year (2019) (Figure 4.2).

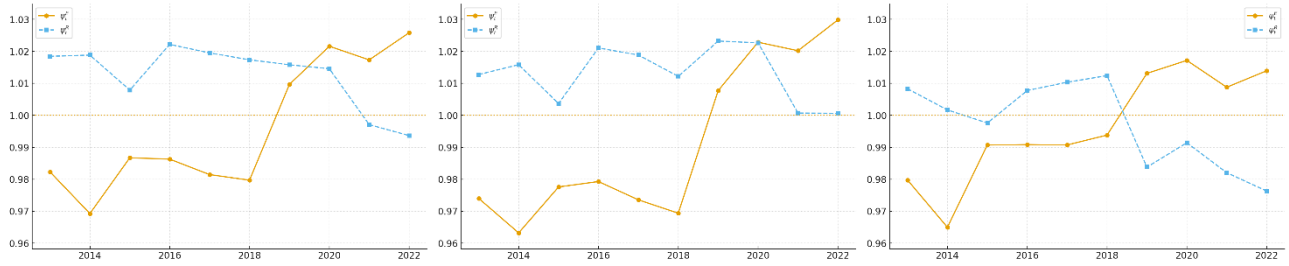
To assess the aggregate content of human capital, we calculate the Ψ_t index which shows how much the loss (or gain) of productivity is due to migration, in percentage terms (Table 4.3). Specifically, Ψ_t is derived as the product of ψ_t (relative human capital per worker) and η_t (the migration rate), making it highly sensitive to fluctuations in the in- and out-flows. The observed growth in the emigration rate over the period contributes to an increase in the loss of aggregate content of human capital, rising from 0.45 to 0.68. This loss peaked in 2020, when Ψ_t^E reached its highest value of 0.77, which, by construction, corresponds to a 0.77% reduction of the aggregate human-capital content relative to the resident population attributable to emigration.

Table 4.2 - Indices ψ_t and γ_t, International migration of Italian aged 25-34

year	ψ_t^E	γ_t^E	ψ_t^R	γ_t^R	ψ_t^N	γ_t^n
2013	0.98	1.15	1.02	1.58	-0.04	-0.43
2014	0.97	1.12	1.02	1.69	-0.05	-0.57
2015	0.99	1.13	1.01	1.44	-0.02	-0.31
2016	0.99	1.10	1.02	1.55	-0.04	-0.46
2017	0.98	1.05	1.02	1.49	-0.04	-0.44
2018	0.98	1.04	1.02	1.45	-0.04	-0.41
2019	1.01	1.35	1.02	1.38	-0.01	-0.03
2020	1.02	1.35	1.02	1.33	0.01	0.02
2021	1.02	1.30	1.00	1.22	0.02	0.09
2022	1.03	1.41	0.99	1.11	0.03	0.30

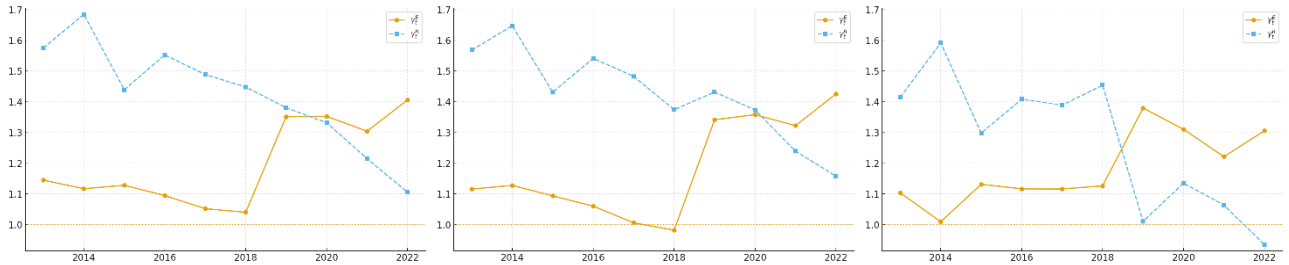
Source: Our elaborations on Istat data.

Figure 4.2 - International brain drain per worker indices



ψ_t Relative human capital per worker

(a) Italy (b) North (c) South



γ_t, Share of young graduates

(d) Italy (e) North (f) South

Source: Our elaborations on Istat data.

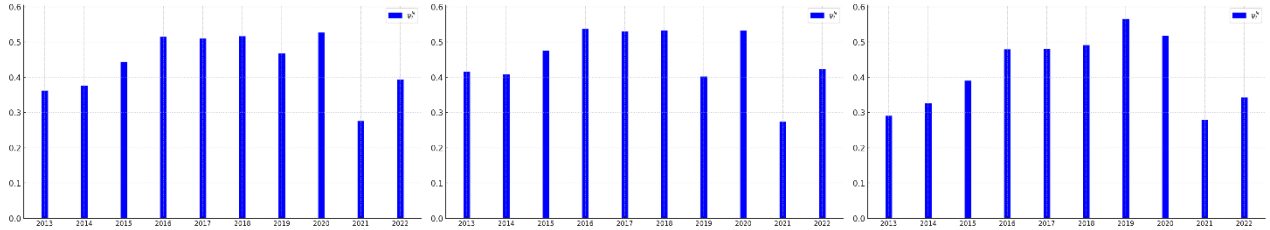
At the same time, the aggregate content of human capital due to Italian returns Ψ_t^R also increased, from 0.08 to 0.28, albeit at a slower rate. Yet emigrant flows remain much larger (in 2022, η_t^E is more than twice as large as η_t^R), so the net index Ψ_t^N, the human-capital index of net migration, stays positive in every year (from 0.36 in 2013 to 0.39 in 2022, peaking at 0.53 in 2020), indicating a persistent net loss of aggregate human capital despite stronger returns.

Table 4.3 - Indices Ψ_t and Γ_t, International migration of Italian aged 25-34

year	Ψ_t^E	Γ_t^E	η_t^E	Ψ_t^R	Γ_t^R	η_t^R	Ψ_t^N	Γ_t^N
2013	0.45	0.52	0.45	0.08	0.13	0.08	0.36	0.39
2014	0.47	0.55	0.49	0.10	0.16	0.10	0.38	0.38
2015	0.55	0.63	0.56	0.11	0.15	0.11	0.44	0.48
2016	0.66	0.74	0.67	0.15	0.23	0.15	0.51	0.51
2017	0.68	0.73	0.69	0.17	0.25	0.17	0.51	0.48
2018	0.71	0.76	0.73	0.20	0.28	0.19	0.52	0.48
2019	0.72	0.97	0.72	0.26	0.35	0.25	0.47	0.62
2020	0.77	1.02	0.75	0.24	0.32	0.24	0.53	0.70
2021	0.60	0.77	0.59	0.33	0.40	0.33	0.28	0.37
2022	0.68	0.93	0.66	0.28	0.31	0.28	0.39	0.61

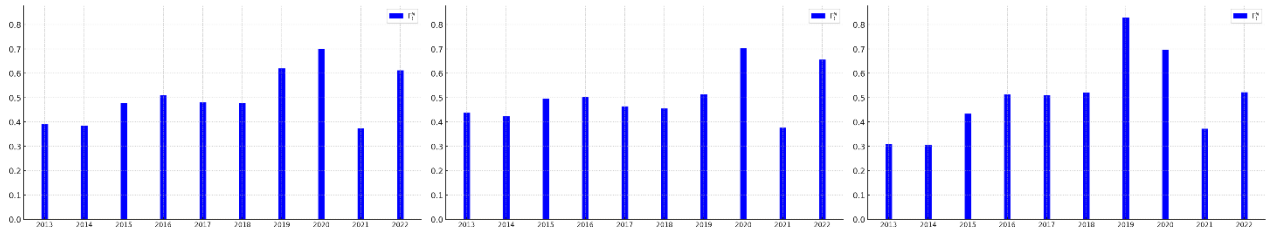
Source: Our elaborations on Istat data.

Figure 4.3 - International brain drain aggregate indices



Ψ_t^N the aggregate loss/gain of human capital from net migration

(a) Italy (b) North (c) South



Γ_t^N the aggregate loss/gain of college graduates due to net migration

(d) Italy (e) North (f) South

Source: Our elaborations on Istat data.

Similarly, the aggregate index Γ_t^E reflects the share of young college graduates who emigrated from Italy. Its positive trend underscores a significant increase, which nearly doubled over the period 2013-2022, rising from 0.52 to 0.93. Conversely, while the Γ_t^R values also show an upward trend, indicating an increase in the share of young college graduates among returns, this share remains consistently lower than that observed among emigrants, keeping Γ_t^N positive throughout (from 0.39 to 0.61). This disparity highlights a persistent imbalance in the skill content levels of emigrants versus returns, with Italy experiencing a net loss of highly educated individuals.

At the regional level, aggregate indices show that the North loses more human capital and graduates, due to international migration, than the national average for most years, while the South loses less but accelerates earlier and more intensely: both areas show an upward trend until 2019-2020, a common decline in 2021 and a partial recovery in 2022.

4.5.2 Internal brain drain

The brain drain indices computed for these movements highlight the actual loss of human capital from southern regions over the decade, referring to both the human capital related productivity relative to residents (ψ_t and Ψ_t) and the skill content of migrants (γ_t and Γ_t). For migrations from South to North, ψ_t^E, which measures the human capital of emigrants, consistently exceeds 1 and shows an upward trend, increasing from 1.04 in 2013 to 1.07 in 2022, this indicates that emigrants possess higher-than-average human capital productivity relative to the population in the South. Conversely, ψ_t^R which captures the human capital of residents returning to the South, also increases over the period but remains consistently lower than ψ_t^E. Its maximum value (1.03 in 2022) is still lower than the minimum value of ψ_t^E, emphasizing

a relative impoverishment of human capital in the South. Regarding the share of college graduates, emigrants are markedly graduate-dense, γ_t^E starting at 1.68 (2013), dipping to 1.44 (2018), spiking to 1.97 (2019), and ending at 1.88 (2022); the young Italian immigrant graduates also exceed residents but by less, with a value of γ_t^R which rises from 1.10 to 1.36 over the decade, and a local high of 1.38 (2019). The share of college graduates in the net migration, γ_t^n remains positive across the decade (0.58–0.52), confirming that South to North flows extract a higher share of graduates than returns can replenish (Table 4.4). As a result, internal migration continuously reallocates productivity-weighted human capital and graduate intensity from the South to the North. Selectivity[27] spikes in 2019, and although returns improve thereafter, the net drain persists.

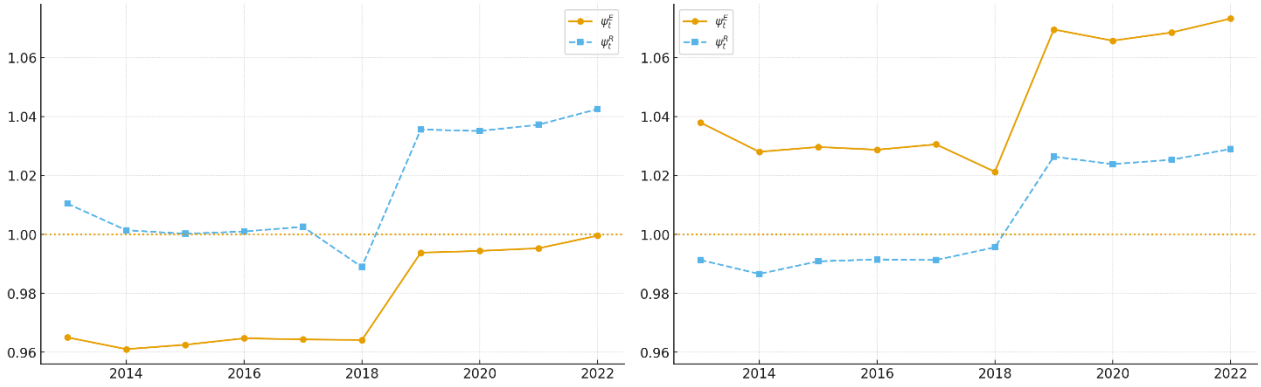
Table 4.4 - Indices ψ_t and γ_t, Internal migration from South to North of Italian aged 25-34

year	ψ_t^E	γ_t^E	ψ_t^R	γ_t^R	ψ_t^N	γ_t^n
2013	1.04	1.68	0.99	1.10	0.05	0.58
2014	1.03	1.57	0.99	1.14	0.04	0.43
2015	1.03	1.53	0.99	1.08	0.04	0.46
2016	1.03	1.51	0.99	1.06	0.04	0.44
2017	1.03	1.51	0.99	1.06	0.04	0.45
2018	1.02	1.44	1.00	1.13	0.03	0.31
2019	1.07	1.97	1.03	1.38	0.04	0.59
2020	1.07	1.82	1.02	1.33	0.04	0.49
2021	1.07	1.82	1.03	1.34	0.04	0.49
2022	1.07	1.88	1.03	1.36	0.04	0.52

Source: Our elaborations on Istat data.

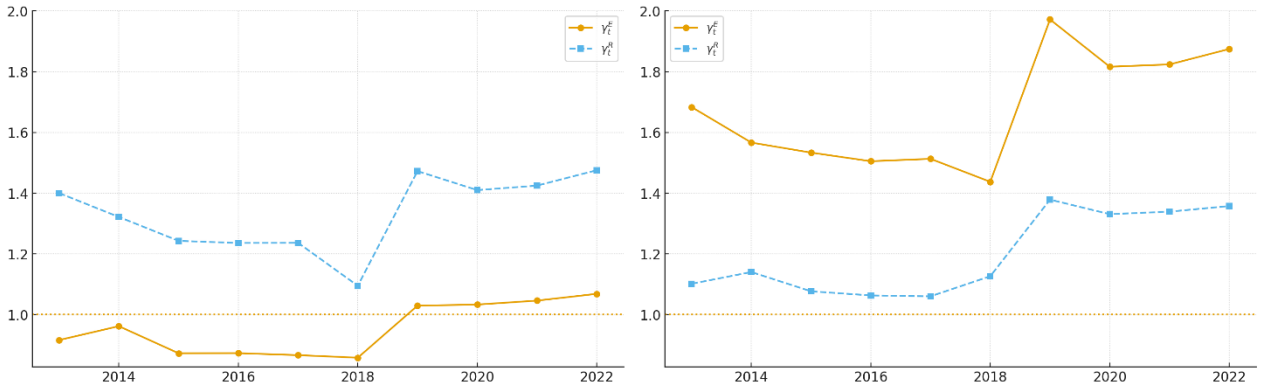
[27] *Selectivity* denotes the composition gap between movers and the resident population—i.e., the extent to which migrants are more or less qualified than residents. It captures differences in educational attainment or in relative human capital per worker. *Positive selectivity* means that, on average, those who leave possess higher human capital (or a higher graduate share) than residents. *Negative selectivity* is the converse: movers are, on average, less qualified than residents (lower graduate share or relative human capital per worker). For outflows, this attenuates the loss at origin; for return flows, it limits the replenishment.

Figure 4.4 - Internal brain drain per worker indices



ψ_t Relative human capital per worker

(a) North to South (b) South to North



γ_t, Share of young graduates

(a) North to South (b) South to North

Source: Our elaborations on Istat data.

The comparison shows that the dynamics of ψ_t^E (orange line) and ψ_t^R (blue line) differ markedly between North and South. In the North–South direction, relative human capital per worker remains at or below unity, with the exception of the immigrant-based measure (ψ_t^R) which rises above one from 2019 onwards. In contrast, the South–North perspective indicates values generally above one, with returns remaining below unity until 2019 before increasing. The trends for γ_t^E (orange line) and γ_t^R (blue line) are consistent with this pattern: while North–South ratios for γ_t^E remain below one, the reverse comparison systematically exceeds one, especially after 2019, pointing to a stronger dynamic of graduate human capital in the South (Figure 4.4).

The aggregate indices paint a very clear picture. The Ψ_t^E, which represents the overall loss of human capital due to emigration, shows a dramatic increase over time, rises sharply from 1.68 to 2.43, with a first spike in 2019 (2.24) and a new peak in 2022 (2.43), indicating that both the volume of South to North moves (η_t^E grows from 1.62 to 2.27) and their quality (from the ψ/γ evidence) are extracting more productivity-weighted human capital than earlier in the decade (Table 4.5). By contrast, Ψ_t^R, the aggregate

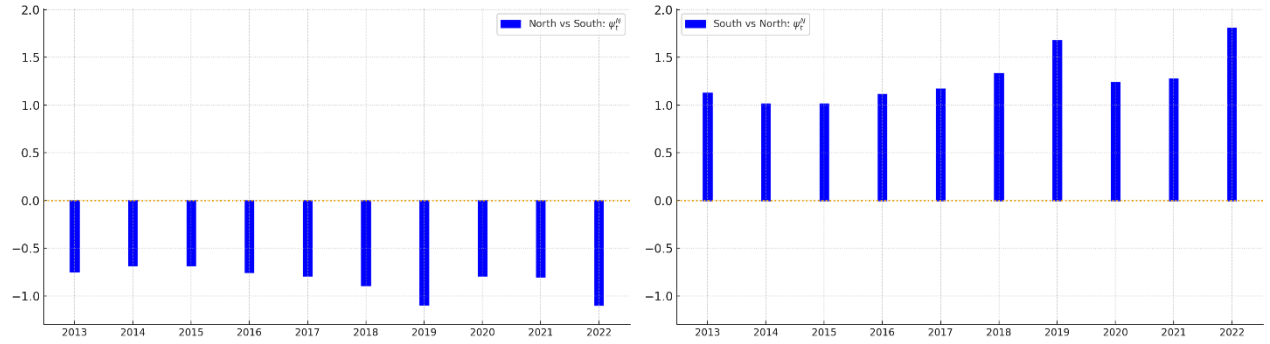
human-capital gain index from North to South returnees, remains much smaller and edges up only from 0.56 to 0.62, reflecting modest growth in return flows (η_t^R rises from 0.56 to 0.60). The net index Ψ_t^N (the human-capital index of net internal migration from the South's perspective) is positive in every year and increases from 1.13 to 1.81, with a pandemic-related dip in 2020 (1.24) and a strong rebound thereafter, signaling a persistent and strengthening net loss of aggregate human capital. The values of Γ_t^N for South to North indicate a persistent loss of college graduates of the South throughout the decade. After starting in 2013 at about 2.11, the index declined slightly before gradually increasing again. A sharp surge is observed in 2019, when the relative advantage reached 3.38, more than doubling the mid-decade minimum. In percentage terms, this means that the South has lost 3.43% of its graduates due to net migration to the North.

Table 4.5 - Indices Ψ_t and Γ_t, Internal migration from South to North of Italian aged 25-34

year	Ψ_t^E	Γ_t^E	η_t^E	Ψ_t^R	Γ_t^R	η_t^R	Ψ_t^N	Γ_t^N
2013	1.68	2.73	1.62	0.56	0.62	0.56	1.13	2.11
2014	1.55	2.35	1.50	0.53	0.61	0.54	1.01	1.74
2015	1.51	2.25	1.47	0.50	0.54	0.50	1.02	1.71
2016	1.61	2.35	1.56	0.49	0.53	0.50	1.12	1.83
2017	1.64	2.41	1.59	0.47	0.50	0.47	1.17	1.91
2018	1.80	2.53	1.76	0.46	0.53	0.47	1.33	2.00
2019	2.24	4.13	2.10	0.56	0.76	0.55	1.68	3.38
2020	1.83	3.12	1.72	0.59	0.77	0.58	1.24	2.35
2021	1.88	3.21	1.76	0.60	0.78	0.58	1.28	2.42
2022	2.43	4.25	2.27	0.62	0.82	0.60	1.81	3.43

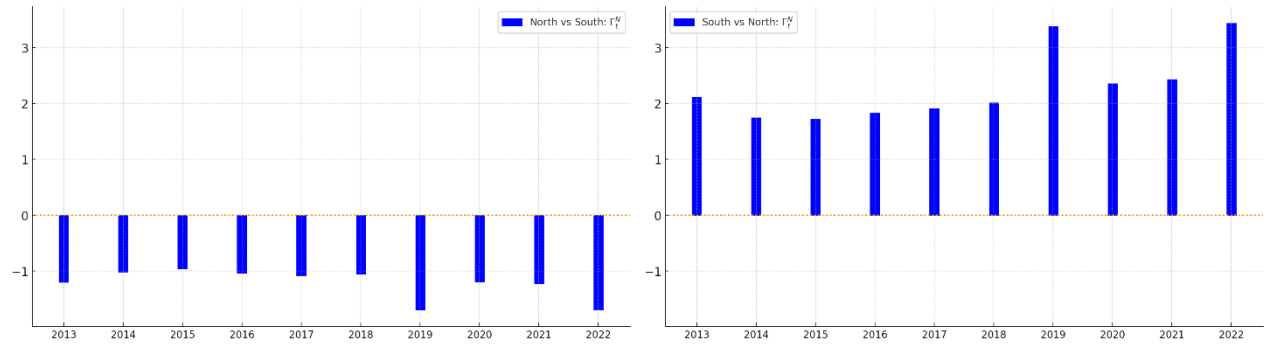
Source: Our elaborations on Istat data.

Figure 4.5 - Internal brain drain: aggregate indices



(a) North (b) South

Ψ_t^N the aggregate loss/gain of human capital from net internal migration



(c) North (d) South

Γ_t^N the aggregate loss/gain of college graduates due to net internal migration

Source: Our elaborations on Istat data.

At regional level, the relative index shows opposite signs by construction: negative for North to South and positive for South to North. The trend is broadly stable until 2018, with a sharp divergence in 2019, when the South reaches its maximum relative advantage. After a partial adjustment in 2020–2021, the gap widens again in 2022, confirming a stronger relative position of the South compared to the North.

4.5.3 Total brain drain: international plus internal

Throughout the period observed, thanks to migration flows from the South, the North managed to compensate for the loss of human capital due to international emigration. However, this net gain has gradually decreased over time. The index ψ_t^N, which represents the relative human capital per worker of net total migration, for the North narrowed from -0.04 in 2013 to -0.02 in 2022, while γ_t^N shrank from -0.38 to -0.12. This decline is mainly due to the increase in international brain drain, not to the reduction in internal inflows (Table 4.6). In contrast, the South has suffered net losses in terms of human capital, both from international migration and from movements to the North. From 2013 to 2018, there were signs of improvement, but the trend reversed from 2019 onwards, largely due to intensified international emigration.

By 2022, the high value of Γ_t^N index in the South, means that that the human capital of young graduates

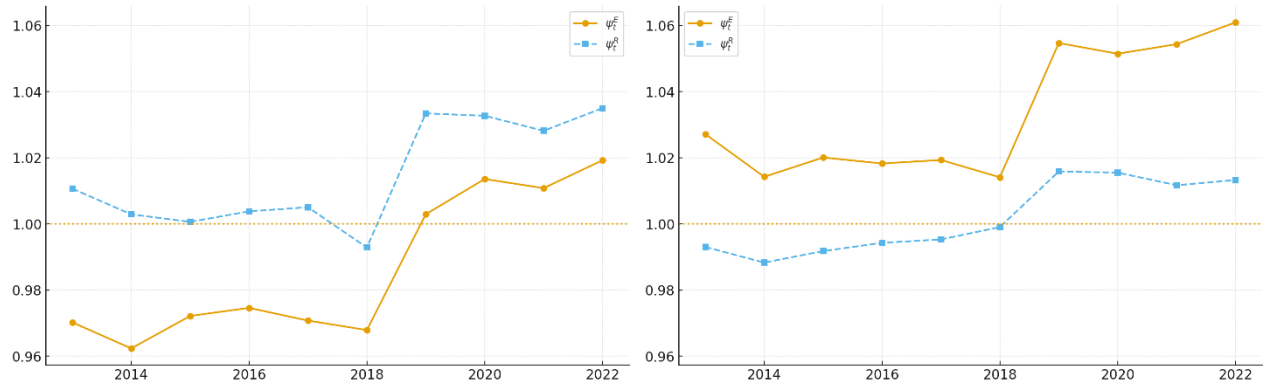
in the South has been reduced by 3.95% due to emigration abroad and to the North. The mirror values for the North remain negative ($\Gamma_t^N \approx -1.03$ in 2022), highlighting that the South suffers a disproportionate loss.

Table 4.6 - Brain drain indices of net total migration

	North						South					
	international net migration rate	internal net migration rate	ψ_t^N	Ψ_t^N	γ_t^N	Γ_t^N	international net migration rate	internal net migration rate	ψ_t^N	Ψ_t^N	γ_t^N	Γ_t^N
2013	-0.43	0.72	-0.04	-0.33	-0.38	-0.76	-0.30	-1.06	0.03	1.41	0.44	2.42
2014	-0.43	0.66	-0.04	-0.27	-0.29	-0.59	-0.34	-0.96	0.03	1.34	0.26	2.04
2015	-0.49	0.67	-0.03	-0.20	-0.25	-0.46	-0.39	-0.97	0.03	1.40	0.33	2.14
2016	-0.55	0.74	-0.03	-0.22	-0.28	-0.54	-0.48	-1.07	0.02	1.59	0.28	2.34
2017	-0.55	0.78	-0.03	-0.26	-0.31	-0.62	-0.49	-1.12	0.02	1.65	0.27	2.41
2018	-0.56	0.89	-0.02	-0.36	-0.20	-0.6	-0.50	-1.29	0.02	1.82	0.16	2.52
2019	-0.40	1.04	-0.03	-0.69	-0.23	-1.18	-0.55	-1.55	0.04	2.24	0.53	4.2
2020	-0.52	0.75	-0.02	-0.26	-0.15	-0.49	-0.50	-1.14	0.04	1.76	0.39	3.04
2021	-0.26	0.76	-0.02	-0.53	-0.16	-0.85	-0.27	-1.17	0.04	1.56	0.43	2.79
2022	-0.40	1.04	-0.02	-0.68	-0.12	-1.03	-0.33	-1.66	0.05	2.15	0.53	3.95

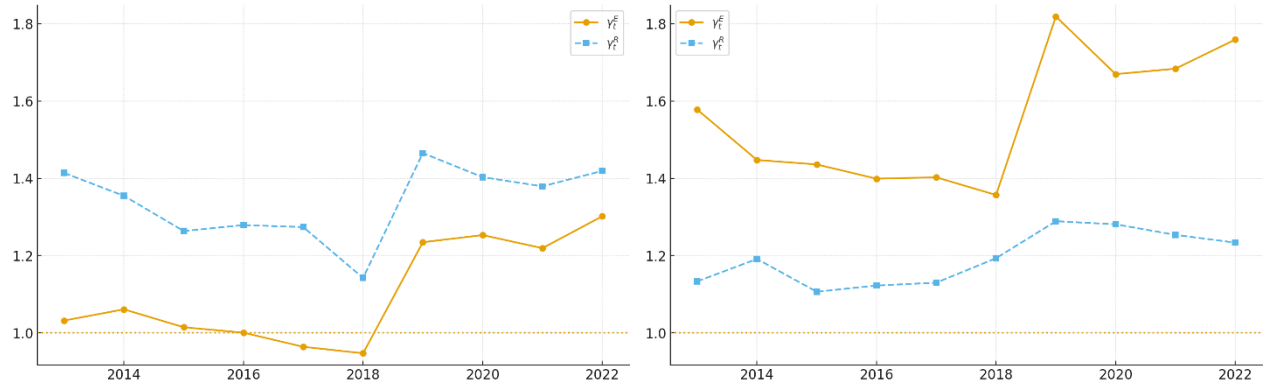
Source: Our elaborations on Istat data.

Figure 4.6 - Total brain drain: per worker indices



ψ_t Relative human capital per worker

(a) North (b) South



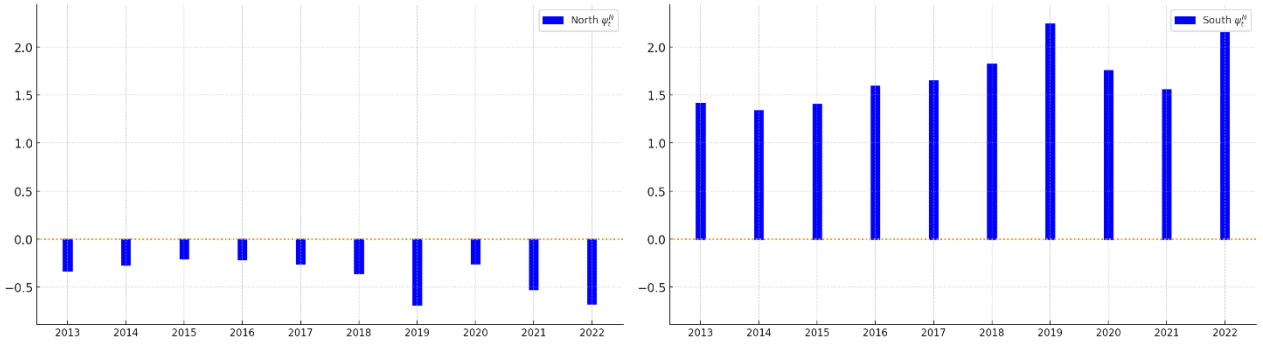
γ_t, Share of young graduates

(a) North (b) South

Source: author's elaboration on Istat data.

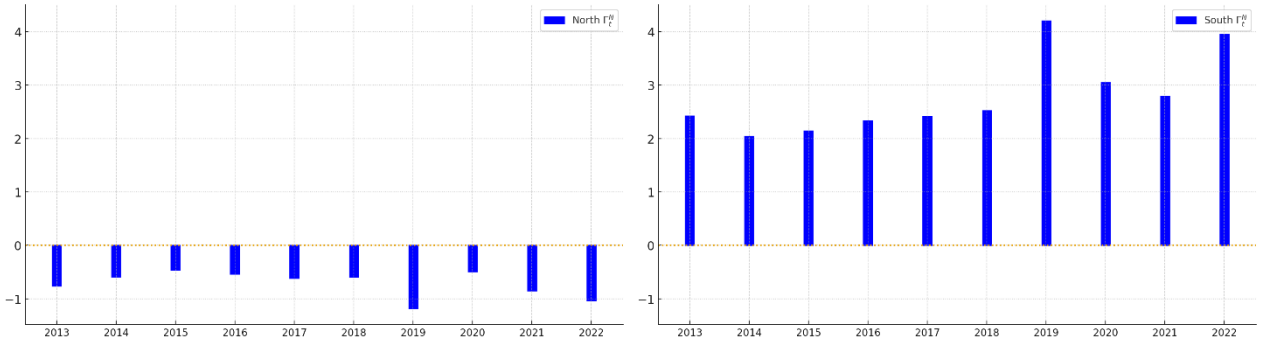
For both macro-areas, the two indices ψ_t^E (orange line) and ψ_t^R (blue line) move in a relatively narrow band around unity, but with important nuances. In the North, emigrants' relative human capital remains below 1 until 2018, then crosses the threshold and stays persistently above it, while returns are consistently close to or slightly above 1, with a marked upward shift after 2019. In addition, the γ_t^E index hovers around unity until 2018 and then rises markedly, while γ_t^R (blue line) stays persistently high, above 1.2, with a new peak after 2019. In the South, emigrants' index is systematically above 1 throughout the period, showing an accentuation after 2018, whereas returns remain just below unity until 2018 and only exceed 1 marginally thereafter. Moreover, γ_t^E is consistently much higher than in the North, with a sharp surge in 2019, whereas γ_t^R remains more stable, only slightly above 1.2 (Figure 4.6).

Figure 4.7 - Total brain drain: aggregate loss of human capital



Ψ_t^N the aggregate loss/gain of human capital from net total migration

(a) North (b) South



Γ_t^N the aggregate loss/gain of college graduates due to net total migration

(a) North (b) South

Source: Our elaborations on Istat data.

Regarding the aggregate indicators for total net migration (Figure 4.7), the series diverge persistently: the North remains negative throughout the period, suggesting a gain in human capital, especially in 2019. Conversely, in the South both indicators are positive in all years, with a maximum loss in 2019. This trend indicates a structural disadvantage for the South compared to the North throughout the entire period.

In a nutshell, the analysis conducted so far has highlighted the dramatic issue of brain drain in the South of Italy. It seems that this region is destined to experience a significant loss of human capital, particularly among young graduates, both abroad and internally. Internal brain drain from the South appears to be constant over time, while international brain drain appears to be increasing in recent years, as does brain drain from the North. The latter area still manages to offset the net loss abroad with a strong net gain from the South. However, recent dynamics indicate that this compensation is decreasing, meaning that a total net brain drain may emerge for the North in the future (*ceteris paribus*).

4.6 The contribution of foreign migrants

In recent years, the immigration of highly educated young foreigners has played a significant role in reshaping the dynamics of brain drain. The new data released by Istat for the first time in 2025, expand the information base and enable a shift from a *brain drain*–centered reading to a *brain circulation*

perspective. In this light, the indicators previously computed for Italian nationals are recalibrated to include human young foreigners as well, providing a more comprehensive view of talent flows into and out of the country.

Using the same reference population is essential to compare Italians and foreigners cleanly and to decompose totals into group-specific contributions. All indices, per-capita (ψ, γ), aggregate (Ψ, Γ), and flow rates (η), should be normalized to the same population (total young residents aged 25–34). With a common denominator, the aggregate indicators become additive by construction: the net human-capital content of total migration satisfies Ψ(total) = Ψ(Italians) + Ψ(Foreigners), and likewise for the graduate aggregate Γ. The per-capita net measures are then interpretable as flow-weighted differences, so the total ψ and γ are consistent weighted combinations of the subgroup values. If, instead, Italians were scaled to Italian residents and foreigners to foreign residents, neither additivity nor a meaningful Italian–foreign split would hold, and the same totals could not be reconciled.

According to Istat data (2025), between 2019 and 2022[28], the population aged 25-34 balance remains positive entirely thanks to foreigner young immigrants, whose numbers grow by over 250,000, offsetting the loss of 90,000 Italians, for a net balance of just under 160,000. Even more evident is the trend among 25–34-year-old graduates, where the overall balance is only slightly positive (+6,000) thanks to the foreign contribution (+48,000), while Italian graduates in the same age group lost over 41,000 in four years.

Applied to results for 2019–2022, the common baseline shows a sharp contrast between quality and quantity. At national level, Italians exhibit a persistently adverse aggregate net balance with positive values over the period (Ψ_t^N goes from 0.44 to 0.34), signaling losses driven by both selection and scale. Foreigners show the opposite pattern for Ψ_t^N (about -0.86 to -1.24), indicating a large aggregate gain in human capital for Italy; adding the two, the total (Italians and foreigners) Ψ_t^N becomes negative and increasingly so over time (around -0.42 to -0.90), meaning that foreign inflows more than offset Italian outflows in aggregate, fully offsetting the loss of human capital described above. The aggregate graduate measures tell a consistent story: the overall Γ_t^N is negative in most years because the volume of graduate inflows among foreigners dominates (increasing from -0.69 to -0.74), contrasting loses of Italian graduates over the period and producing an aggregate gain: once scaled to the same population, the indicators reveal that foreigners drive the aggregate improvement in Italy's human capital stock (Table 4.7).

[28] Data on the educational attainment of foreign migrants is available from 2019 onwards

Table 4.7 - Indices Ψ_t and Γ_t, International net migration of Italian and foreigners aged 25-34

	Italy		North		South	
	Ψ_t^N	Γ_t^N	Ψ_t^N	Γ_t^N	Ψ_t^N	Γ_t^N
Italians+foreigners						
2019	-0.42	-0.12	-0.72	-0.41	0.11	0.50
2020	-0.25	0.21	-0.43	0.06	0.08	0.51
2021	-0.62	-0.24	-0.81	-0.41	-0.28	0.13
2022	-0.9	-0.17	-1.11	-0.32	-0.51	0.17
Italians						
2019	0.44	0.57	0.36	0.46	0.58	0.80
2020	0.46	0.65	0.44	0.64	0.49	0.68
2021	0.24	0.34	0.23	0.34	0.26	0.36
2022	0.34	0.57	0.35	0.60	0.32	0.51
foreigners						
2019	-0.86	-0.69	-1.08	-0.88	-0.47	-0.31
2020	-0.70	-0.45	-0.87	-0.57	-0.41	-0.17
2021	-0.86	-0.58	-1.04	-0.75	-0.54	-0.23
2022	-1.24	-0.74	-1.46	-0.91	-0.83	-0.34

Source: Our elaborations on Istat data.

Taken together, these results highlight a clear asymmetry between the contribution of Italian and foreign migrants to Italy's human capital balance. The emigration of Italians is characterized by strong positive selection among the highly educated and therefore generates losses in per-capita human capital. By contrast, the contribution of foreign migrants operates mainly through volume effects rather than through a comparable quality premium. As a result, foreign inflows are sufficient to offset Italian losses in aggregate terms, but they do not fully compensate for the higher human-capital content embodied in Italian outflows. This distinction helps reconcile improving aggregate indicators with persistently unfavorable per-worker measures.

At regional level, the mechanism is even more pronounced. The Italians + foreigners total shows an increase in aggregate productivity and skill contents, with values higher than at the national ones, thanks to the strong foreign component, which more than compensates for the erosion of the human capital of young Italian resident (positive on both measures). In the South, the contribution of foreigners is also favorable but less powerful than in the North, and the aggregate human capital is not completely offset by their contribution.

4.7 Conclusion

This paper develops an integrated measurement framework for brain drain that combines per-worker selection (ψ), flow scale (η), and aggregate impact (Ψ), with graduate-specific analogues (γ, Γ). We apply these indicators consistently to international outflows, return migration, internal South to North mobility for young adults aged 25–34, and, using recent available data, for total population (Italians and foreigners). Read through this lens, Italy's recent experience is characterized by three concurrent dynamics: a

deterioration in the international per-worker balance, a territorially asymmetric reallocation of human capital from the South to the North, and sizable aggregate gains from foreign inflows that do not, however, close the per-worker quality gap created by positively selected Italian outflows.

On the international perspective, our analysis shows a turning point in the per-worker indices: until 2018, emigrants' human capital per worker (ψ_t^E) was slightly below residents and returnees' (ψ_t^R); since 2019 there has been a reversal of this trend and ψ_t^N becomes positive, indicating that, on average, Italians who leave the country have greater human capital than those who return. The graduates index tells the same story, with the net graduate composition (γ_t^N) worsening after 2019. International brain drain therefore materializes first as a problem of per-worker quality and then, on a large scale, as an aggregate loss when foreigners are not taken into account (*answer to RQ1*).

Including foreign migrants changes magnitudes but not mechanisms. Foreign inflows systematically deliver negative aggregate brain drain indicators, showing that their contribution more than offset Italians' aggregate losses when the two are summed (*answer to RQ3*).

Internal mobility magnifies territorial imbalances. For South to North movements, ψ_t^E exceeds one in every year and ψ_t^N is positive from the South's perspective: the per-worker loss is small but unrelenting. The college graduate index reinforces the point: γ_t^E is high and volatile (with a notable spike in 2019), γ_t^R is above one but smaller, and γ_t^N remains positive across the decade. Put differently, even as Italy loses human capital abroad, it rebalances internally toward its more dynamic poles. On the aggregate side, Ψ_t^E rises over time as both scale and selection intensify, while Ψ_t^R remains modest; the result is a growing net aggregate loss for the South and a mirror-image gain for the North. The North partly insures itself against international losses by drawing from the South, which, by contrast, faces a double drain, external and internal, with clear implications for long-run divergence in productivity, innovation capacity, and technology absorption (*answer to RQ2*).

The crucial point is a quality–quantity trade-off: inflows are large enough to improve aggregates, including the stock of graduates, but not selective enough to overturn the per-worker disadvantage generated by who leaves.

These findings are consistent with a brain-circulation perspective rather than a pure brain-drain narrative. Italy is not short of inflows; it is short of the right combination of inflows and returns to counterbalance the selection embedded in outflows, and it continues to reallocate talent internally toward the regions that already lead. The policy implications therefore differ across margins. Nationally, the priority is to raise the quality and scale of returns and to recognize skills among foreign inflows. That requires career ladders that are credible at early stages (tenure-track-like pathways, competitive postdocs, multi-year return programs), rapid acknowledgement of skills acquired abroad, and targeted yet conditional incentives that reward durable attachment to the research system and high-productivity firms. For foreign inflows, the agenda is about matching and utilization: fast recognition of foreign degrees and professional

credentials, streamlined access to regulated occupations, specialized job-matching for high-skill entrants, and mentoring bridges between universities and firms to prevent underemployment.

Territorially, the South needs place-based investments that tackle the drivers of selective internal outflows: more and better first jobs for graduates in the private sector, stronger capacity to absorb R&D and transfer technology (university–firm networks, industrial PhDs, clusters), and improvements in local institutions and services that make cities attractive for young adults. The North, which has benefited from internal rebalancing, should avoid relying structurally on inflows from the South and from abroad by deepening on-the-job training, raising within-region upskilling, and, above all, strengthening its ability to retain Italian graduates who currently choose to leave.

Methodologically, the indicators provide a decomposable scoreboard, by channel (international vs internal), citizenship (Italians vs foreigners), and territory (Italy, macro-areas), that can be updated annually. Limitations remain: register data entail lags in residence updates and imperfect coverage of short-cycle circular moves; the Mincer mapping depends on an assumed return to schooling (β), which should be stress-tested over plausible ranges; the indicators summarize educational quantity more than skills specificity. Future work should extend the framework to field of study and occupational quality, link it to innovation outcomes (patents, R&D employment, and high-growth firms), and exploit longitudinal micro-data to map trajectories (sequence or multi-state models) that distinguish temporary spells from durable relocations.

However, a limitation of this study is that we cannot distinguish migrants by field of study. Register-based data do not provide harmonized information on degree discipline for the full period, so our indicators capture educational quantity rather than skill specificity. Extending the framework to STEM and field-specific measures is a key direction for future research.

A further caveat concerns the time window covered by the analysis. The period 2019–2022 includes the COVID-19 pandemic, which may have temporarily affected both the volume and the composition of migration flows. Mobility restrictions, delayed registrations of residential moves, and short-term changes in labor demand may have altered patterns of emigration, return migration, and foreign inflows during these years. In particular, the educational profile of foreign migrants observed in this period may partly reflect pandemic-specific dynamics rather than stable long-run trends. While these factors may influence the level of the estimated indices in individual years, they are less likely to overturn the main qualitative findings, which rely on systematic differences between outflows and inflows and on the comparison between per-capita and aggregate measures. Extending the analysis to a longer post-pandemic horizon as data become available represents a natural direction for future research.

Even with these caveats, the evidence is unambiguous. For the country as a whole, foreign inflows generate tangible aggregate gains, including in graduates, but the per-worker disadvantage persists because the Italians who leave are highly selected and the premium of returnees has narrowed. For the

South, international outflows compound a persistent internal drain, producing a structural net loss. Italy's challenge is therefore not merely "how many arrive," but "who leaves, who returns, and where internal movers go." Progress will be measured by whether policies can shift those three levers, retention, return, and internal allocation, so that mobility becomes genuine circulation of knowledge rather than a one-way extraction of talent.

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A4. ANNEX

The index relies on a return-to-schooling parameter β, interpreted as the wage premium associated with an additional year of education in a Mincer regression. Using β to weight education groups serves two purposes. First, it recognizes that tertiary graduates and lower-secondary graduates do not contribute equally to productive capacity. Second, it allows migration flows to be compared not only in terms of their size, but in terms of the *economic value* they represent. As shown in Becker et al. (2004) and Caselli (2005), this adjustment is standard in human-capital-based comparisons across populations.

Varying the assumed return to education over a wide range, from conservative EU-based estimates (β = 0.03), to the baseline value used in the literature (0.035), up to higher-return OECD assumptions (0.05) and even an upper-bound stress-test for high-wage-inequality countries (0.07) , produces only marginal adjustments in both per-worker and aggregate indices. In all cases, ψ_E and ψ_R rise mechanically with β, as expected from the exponential reward function, but they do so in parallel, such that the gap between emigrants and residents remains effectively unchanged. This indicates that the assessment of *relative selection* is not an artefact of the chosen wage premium.

A similar pattern emerges for the aggregate indices (Ψ). Even when the wage return is doubled relative to the baseline, the aggregate balance shifts by less than 0.002 points, a difference too small to alter any substantive conclusion about whether outflows and inflows compensate or exacerbate one another. In short, the direction and magnitude of Italy's brain-drain patterns are structurally robust, not parametrically fragile. What drives the results is the *composition* of movers rather than the *reward assigned* to their schooling. This strengthens the credibility of the findings and suggests that policy discussion should focus less on modelling assumptions and more on the persistent asymmetries in mobility profiles.

Table A4.1 - Sensitivity of indices to alternative return-to-education assumptions (β)

β	Source / Scenario	ψ_E (per-worker)	ψ_R (per-worker)	Ψ_E	Ψ_R	Interpretation
0.03	Lower-bound from EU evidence	1.002	1.003	0.707	0.263	Minimal variation in both per-worker and aggregate indices; overall picture unchanged.
0.035 (baseline)	Becker et al. (2004) — benchmark in the chapter	1.003	1.003	0.707	0.263	Reference case; virtually identical to the low-return scenario.
0.05	OECD / Psacharopoulos higher-return estimate	1.004	1.005	0.708	0.264	Slight mechanical increase in both aggregates; economically negligible.
0.07	Upper-bound for high-wage-inequality countries	1.005	1.007	0.709	0.264	Stress-test: per-worker levels increase, but in parallel; aggregate balance remains almost unchanged.

Note: The Beta parameter is the average beta value for the period (2013-2022) and it refers to international movements.

Chapter 5. Final remarks and discussion

5.1 Overall overview

This final chapter synthesizes the main findings of the three essays and discusses their shared implications for understanding migration as a mechanism that redistributes population and human capital across space. Building on the conceptual framework introduced in Chapter 1, the chapter brings together evidence on how different forms of mobility reshape demographic and economic outcomes across Italian territories. Although each essay focuses on a specific dimension of migration, they share a common objective: to improve our understanding of the processes through which mobility reallocates people, age structures, and skills, thereby contributing to the evolution of territorial inequalities.

The three essays contribute to the scientific debate on territorial mobility by combining innovative empirical strategies with rigorous measurement of migration dimensions that remain underexplored in the literature. In many cases, these gaps stem from the limited availability of data sources with sufficient informational richness and territorial granularity, conditions that are essential for observing redistributive processes at the local level and for capturing spatial heterogeneity. Within this framework, each essay adopts a distinct yet complementary perspective, while jointly advancing a coherent empirical approach to studying how migration regulates the spatial allocation of population and its demographic and economic consequences.

The empirical foundation of the analyses is the Istat data on Internal and International Migration of the Resident Population, which represents an outstanding data source for studying migration flows. It allows for precise measurement of the intensity and direction of movements and for the detailed description of the main socio-demographic characteristics of migrants. The use of administrative data ensures complete territorial coverage and temporal continuity, making it possible to construct indicators that are comparable across time and space and to analyze sub-regional differences that are often invisible in sample-based sources.

At the same time, as with all administrative data, this source also presents some limitations, mainly linked to delays or underreporting, which can affect the quality of registry records. It is also well known that the source lacks qualitative information (such as motivations, expectations, social networks, or housing and employment conditions at departure and arrival), thereby limiting the capacity to interpret the processes underlying the observed trajectories.

Overall, the empirical design maximizes the strengths of the data source in terms of coverage, granularity, and temporal stability, while mitigating its limitations, thereby producing robust and replicable evidence. In doing so, the three essays not only expand the knowledge base on internal and international migration in Italy but also provide interpretive tools that can inform policy evaluation and the design of *place-based* interventions tailored to territorial specificities.

5.2 Essay 1 on Brexit uncertainty and migration diversion (Chapter 2)

The first essay analyzes the effects of a policy not at the time of its formal introduction but during the preceding phase, when regulatory uncertainty generates ambiguity, shapes expectations, and consequently influences individual behavior. Specifically, it shows how uncertainty surrounding future immigration rules can reallocate migration flows across destinations even before institutional conditions are altered.

The context is the 2016 Brexit referendum. The Italian case is particularly instructive: for decades, the United Kingdom (UK) has been one of the main destinations for emigration from Italy, especially among young and highly educated individuals. The anticipation of a future "points-based" immigration system, more selective but not yet implemented, likely altered the cost–benefit calculations of potential migrants, prompting them to reconsider whether and where to migrate, and in particular whether the UK would remain an attractive destination under possible restrictions.

To measure these anticipatory effects, the essay adopts a counterfactual approach that estimates the impact of the Brexit referendum and, more precisely, of the uncertainty it generated on migration flows from Italy. The aim is to estimate what migration from Italy to the UK would have been in the absence of the political shock, thereby reconstructing an unobservable "alternative world." In this setting, the counterfactual design compares two groups of emigrants distinguished by citizenship status: i) the treatment group, composed of EU citizens (including Italians) migrating from Italy to other destinations, excluding the UK; and ii) the control group, consisting of non-EU citizens, for whom freedom of movement does not apply and whose destination choices are thus less sensitive to uncertainty related to the British referendum.

Consistent with counterfactual logic, the control group must be similar to the treated group in all relevant observable and unobservable characteristics, except for exposure to the shock under investigation. Since only EU citizens enjoyed full freedom of movement to the UK prior to Brexit, the political uncertainty generated by the referendum could alter their expectations and migration decisions, but not those of non-EU citizens already subject to regulated entry regimes.

The model, estimated in a difference-in-differences / event-study framework, identifies differential changes in migration flows over time between the two groups by comparing pre- and post-referendum trajectories. The parallel trends assumption is empirically verified: in the absence of the shock, the trends in EU and non-EU flows evolved similarly. The inclusion of group and period fixed effects controls for all time-invariant structural factors (such as age composition, pre-existing migrant networks, and the economic structure of destination countries), while common time effects capture shared macroeconomic shocks (e.g., cyclical crises, labor market changes across Europe).

The counterfactual setup isolates the specific effect of the uncertainty induced by the Brexit referendum from the many endogenous forces shaping migration flows over time. The results reveal clear evidence

of *migration diversion*: the mere expectation of more selective immigration rules in the UK was sufficient to redirect part of Italy's outflows toward alternative destinations, even before the points-based system was introduced. This response is not homogeneous. First, it varies by citizenship status: the effect is pronounced among Italian citizens, but not significant among residents of other EU countries living in Italy, consistent with a more transitory pattern of intra-EU or return mobility in the latter group. Second, diversion is selective by human capital: among Italian-born individuals, those with lower educational attainment are significantly more likely to change destination, while the effect is statistically null for highly educated young Italians. This pattern aligns with the expectation that a future "skills-based" system in the UK would remain relatively open to high-skilled profiles, reducing their incentive to diversify destinations. Overall, the evidence supports a causal interpretation in terms of an *anticipatory response* to institutional uncertainty, ruling out alternative explanations based on persistent structural differences or common temporal shocks. Substantively, two implications follow: (1) migration policies exert effects already at the stage of credible announcement or expectation, through channels of anticipation and individual *risk assessment*; and (2) these effects are not neutral with respect to the skill composition of migration flows, with potential consequences for the spatial distribution of human capital between origin and destination countries even before policy changes are formally enacted.

5.2.1 Some open issues

The study leaves some open questions. First, although the data are of certified high quality, their ability to capture *actual movement* may be limited: part of the observed variation could reflect administrative regularizations (particularly among Italians already residing in the UK) who registered with AIRE (Anagrafe degli Italiani Residenti all'Estero) to secure or demonstrate *settled status*, rather than new migrations. Official statistic reports suggest that such a "Brexit effect" does exist (Istat, various years); however, the adopted methodology (event-study/DiD) cannot fully disentangle changes in real flows from changes in registration behavior, an inherently difficult factor to observe or control. Consequently, the results should be interpreted as estimates of the net observable effect as reflected in administrative data, acknowledging the possible contribution of this documentary component.

While we did analyze uncertainty rather than the effect of policy, our time frame covers the period from 2012 to 2019 and should have considered at least the first few months of 2020, when Brexit actually took effect. However, starting in March 2020, the COVID-19 pandemic profoundly altered both the volume and direction of migration flows. Although restrictions affected all countries, the heterogeneity of containment policies (in timing, intensity, and duration) may have produced differential effects across areas and periods. As a result, from 2020 onward, flows to and from Italy reflect a combination of two shocks: the effect of the new migration policy linked to Brexit and the effect of pandemic-related uncertainty and restrictions. A natural development of this research would be to disentangle these components to estimate separately the impact of the policy and that of the pandemic shock.

Empirically, post-2020 analyses could extend the counterfactual framework by: *i)* incorporating D/D models that include indices of the severity of health restrictions (both levels and interactions) and dummies for pandemic phases, allowing for group-specific trends after 2020*; ii)* adding a third dimension (e.g., sectors/occupations with varying degrees of mobility or teleworkability, or age classes) to isolate exogenous variation associated with the pandemic from that driven by policy, through a triple-difference model; *iii)* implementing an event study with a structural break, distinguishing two shocks (Brexit and Covid) with separate lead/lag windows and overlap tests; and iv) constructing a pre-2020 counterfactual projection into the pandemic period to measure the *excess migration* attributable to Covid, net of the Brexit-induced trend.

This approach would make it explicit that, from 2020 onward, migration flows incorporate two overlapping shocks, and it would provide a transparent strategy to separate and causally assess their respective impacts.

5.3 Essay 2 on Aging and migration (Chapter 3)

The second essay shifts the focus to the national scale and examines migration as a mechanism that redistributes population aging across territories. In a country characterized by pronounced and uneven demographic decline, the central question is whether mobility mitigates or amplifies territorial imbalances in age structures. Using a spatiotemporal analysis of the Potential Support Ratio (PSR), combined with demographic decomposition and time-varying β-convergence models, the essay provides a nuanced answer.

On the one hand, Italy converges over time towards older structures, with the elderly component driving such convergence, while the working-age component shows signs of divergence, especially early in the period. On the other hand, zooming in on the second decomposition, migration emerges as the non-neutral channel: mortality and cohort turnover have limited or offsetting roles, whereas the allocation of working-age cohorts through mobility redraws the geography of aging.

In particular, internal migration concentrates working-age cohorts in metropolitan and economically dynamic areas, accelerating aging in peripheral municipalities; international migration also contributes to divergence but in a more erratic manner. Maps and time-varying coefficients indicate that convergence intensified in the last decade, partly due to the rapid PSR decline in southern municipalities, while the migration component helps preserve a spatial gradient in working ages. These findings do not claim that migration “ages” places; they show that migration reorganizes them, shifting the centre of gravity of productive ages toward strong poles and exposing inner areas more to unfavorable turnover. The policy implication is immediate: if the goal is to rebalance the age structure, place-based policies for housing, services and opportunities targeting ages 25–39 in net-outflow local systems are needed, alongside a more effective territorial matching of new international arrivals.

5.3.1 Some open issues

The results rely on the Potential Support Ratio (PSR), yet the question of their sensitivity to alternative metrics remains open, for instance, by using prospective indicators that anchor the definition of old age to life expectancy. In this perspective, the rigid chronological threshold (65 years and over) can be replaced by a flexible threshold defined by the age at which Remaining Life Expectancy (RLE) falls below a given value. The implications are substantial: prospective indicators account for temporal and spatial improvements in survival. Defining the "elderly population" dynamically, as a function of longevity, prevents longer-living territories from appearing "older" merely because their residents live longer.

More specifically, an additional specification of β-convergence using the Prospective Potential Support Ratio (PPSR) would add further scientific rigor to the results because it: i) neutralizes mortality differences across territories; ii) ensures comparability across periods, since, when life expectancy increases, standard indicators tend to overestimate aging; and iii) if migration continues to contribute to divergence in the aging process even when prospective indicators are used, the result is more robust, as it is not an artefact of the fixed 65+ threshold.

Moreover, although our model includes a spatio-temporal smooth surface that captures unobserved heterogeneity and autocorrelation, an open issue concerns the well-known problems of scale and zonation (the Modifiable Areal Unit Problem, MAUP). The smooth term handles correlation and continuous gradients, while MAUP concerns aggregation and delineation: the same phenomenon, when aggregated across different spatial units, can yield different estimates even under the same model. A useful robustness check would be to estimate key outcomes at two or more distinct territorial scales (e.g., municipalities, local labor market areas, NUTS-3 regions) and compare results. If the sign, magnitude of coefficients, and geography of gradients remain invariant, we can conclude that the findings are not aggregation artefacts.

Furthermore, even if, as already noted, the spatio-temporal trend captures much of the unobserved heterogeneity, it remains important to consider the role of macro-level shocks, such as exogenous contextual changes, whether economic, health-related, or institutional, that affected the entire territory but with varying intensity across areas during the study period (2002–2023). At least three major shocks can be identified: *i)* the global financial and economic crisis followed by recession (2008–2013), which caused a collapse in employment, slowed internal migration, spurred emigration abroad, and weakened demographic renewal in the most demographically fragile municipalities; *ii)* the pension reform (the "Fornero reform"), which postponed labor market exit, retaining a larger share of individuals of working age in their places of employment and thereby reducing return migration to places of origin. This may have altered the net migration balances of mature cohorts (aged 55–64), which enter the migratory component of the PSR, generating an indirect demographic effect driven by a labor-market policy; and *iii)* the Covid-19 pandemic, which caused a sharp decline in both internal and international mobility and

a rise in mortality, potentially driving an artificial convergence of the PSR, one more influenced by mortality than by migration.

An alternative approach would be to estimate β-convergence in rolling temporal windows that explicitly account for these exogenous shocks. This would allow a stronger claim that convergence mechanisms are not stable but are instead sensitive to macro shocks that act through the channels of mobility and survival.

Finally, the policy implications emerging from this analysis can be reframed as open questions guiding an applied research agenda. First, it is necessary to assess whether, and how, place-based interventions targeting young people can modify residential choices without generating side effects (such as crowding-out or zero-sum territorial competition), and to identify which levers, between housing, services, accessibility, employment opportunities, are truly effective, and in which contexts. Second, the institutional and labor market conditions under which international migration can operate as a channel of demographic rebalancing (rather than merely temporary mitigation) remain to be defined, particularly with respect to integration and stabilization trajectories. Third, the appropriate scale of governance for coordinating demographic, housing, and service policies (local, supra-local, or regional) remains an open question, given variations in administrative capacity and inter-municipal cooperation. Lastly, improving administrative data through the integration of micro-level and qualitative sources remains crucial to reconstruct the motivations, networks, and individual trajectories mediating the effects of policies on flows. Only through this combination can analysis move from territorial diagnosis to the evaluation of policy effectiveness.

5.4 Essay 3 on Measuring human capital and brain drain (Chapter 4)

The third essay addresses the long-standing issue of brain drain, reframing it as a problem of human capital redistribution rather than a one-way loss. The concept of brain drain is characterized by two main controversies. The first is conceptual: should brain drain be defined as a “flight of talents” (a focus on flows) or as the erosion of human capital in regions of origin (a focus on stocks)? The literature offers no consensus and continues to debate the relative merits of flow-, stock-, and hybrid approaches. The second is methodological: how can it be measured in a comparable and information-rich way? Standard procedures, if applied without caution, risk being partial, particularly given the frequent unavailability of consistent data on human capital and educationally selective mobility.

In this essay, we adopt an explicitly stock–flow consistent strategy. On one hand, we measure human capital as a stock, using years of schooling as a broad and replicable proxy; on the other, we quantify brain drain as the outflow of university graduates, following the dominant approach in the literature. This choice is enabled by an Istat dataset that includes educational attainment for both residents and migrants. We nonetheless acknowledge a known limitation of this proxy: education imperfectly captures the central dimension of human capital, namely, effective skills (field of study, skill utilization, and actual

competences).

The originality of our contribution lies in jointly analyzing net migration flows and local structures. It is misleading to speak of brain drain by observing flows alone; it is necessary also to consider the composition of human capital in the areas of origin and the resulting erosive effects. Our formulation thus integrates movements, populations, and contexts, offering a more comprehensive interpretation of the loss or reorganization of human capital across space.

Viewed through this lens, the evidence for the period 2013–2022, referring to individuals aged 25–34, yields three main results. First, until 2019 there are no clear signs of brain drain or human capital erosion: the educational endowment (schooling) of returnees is higher than that of both emigrants and residents in the areas of origin. The picture changes after 2019, when the net per-worker international balance deteriorates: Italian emigrants are, on average, more qualified than residents, while the quality premium of returnees narrows, indicating a loss of quality even in the absence of a collapse in aggregate quantities. Second, internal mobility operates as an asymmetric reallocation mechanism: the North largely offsets foreign losses by attracting human capital from the South, while the latter experiences a double hemorrhage (abroad and toward the North), with cumulative effects on its growth potential. Third, inflows of foreign graduates generate aggregate gains that, in several years, more than compensate the stock loss due to Italians, helping to close the per-worker quality gap opened by increasingly positively selected national emigration. In other words, speaking of an "exodus" is misleading: what is observed is a selective redistribution that benefits strong poles and leaves weaker ones exposed.

5.4.1 Some open issues

A first open question concerns the measurement of human capital, which constitutes the analytical foundation for evaluating *brain drain*. In the essay, human capital is approximated by years of education or the attainment of a university degree, in line with standard practice in the literature and with the informational constraints of administrative data sources. However, this measure captures only the *quantity* of education, not the *quality* of skills effectively embodied in individuals. Further research is therefore needed to develop measures more closely aligned with the theoretical definition of human capital as the set of knowledge, abilities, and productive capacities.

In perspective, research could complement schooling indicators with information on the field of study (to distinguish technical-scientific from humanities profiles), the degree–job match (to measure skill underutilization), or economic outcomes (such as qualified employment, income, and productivity). The objective is to move from a purely formal to a more functional measure of human capital, one capable of capturing qualitative differences across territories and distinguishing between the loss of education and the loss of effectively deployable competences. This evolution would enable *brain drain* to be interpreted not merely as the movement of educated individuals, but as the redistribution of productive and innovative capacities across economic space.

Another of the most promising directions for *brain drain* research is the transition from a demographic–educational measure (how many qualified people leave or return) to a functional–economic measure (what effect these mobilities have on the innovative capacity of territories). The selective mobility of graduates and professionals affects not only the educational endowment of regions, but also their ability to produce and absorb knowledge. Integrating *brain drain* indicators with data on patents, R&D expenditure, research employment, or innovative firms would make it possible to quantify the actual economic impact of human capital losses or gains. This, in turn, would allow a distinction between territories where mobility generates knowledge circulation and those where it produces cognitive depletion, offering a more functional reading of the phenomenon. Future research could therefore assess whether variations in skilled migration flows *precede* or *follow* changes in innovative performance, identifying the institutional, productive, and social conditions that transform human capital mobility from a factor of loss into a driver of development.

Another line of inquiry concerns the non-linear nature of *brain drain* and the possibility that threshold dynamics or *tipping points* may emerge within territories. The loss of qualified human capital does not always produce proportional effects: beyond a certain threshold, it can undermine a region's ability to regenerate knowledge, sustain educational institutions, or attract new competences. In such cases, selective mobility may trigger cumulative decline processes, a kind of *cognitive trap,* in which the reduction of human capital fuels the erosion of productive functions and territorial attractiveness. Empirically identifying these thresholds, for instance through non-linear regression models or spatial cluster analyses, would make it possible to pinpoint vulnerability points beyond which rebalancing policies become less effective. Understanding when and where such threshold effects arise is essential to designing preventive strategies and strengthening the cognitive resilience of local systems.

A further avenue of research concerns the role of foreign migrants in human capital dynamics. Inflows of qualified foreigners may mitigate the loss resulting from Italian emigration, yet they do not always do so functionally. The issue is not merely quantitative but qualitative: the key question is whether these new entrants *replace equivalent competences* or whether they are concentrated in different segments of the labor market, generating only an apparent compensatory effect.

Finally, an important extension involves integrating *brain drain* with demographic dynamics, particularly fertility and age structure. Skilled migration flows primarily involve the core working-age cohorts (25–39 years), those that concentrate the reproductive and educational potential of the population. Their outflow produces a dual loss: cognitive, by reducing the stock of competences, and demographic, by eroding the generational base from which future graduates emerge. In many areas of Southern Italy, the combination of skilled emigration, low fertility, and population aging generates a cumulative effect that limits the capacity to regenerate human capital, creating a true *cognitive–demographic trap*. Integrating human capital indicators with fertility and age structure measures would make it possible to analyze how skill

loss and demographic decline reinforce one another, and to evaluate policies not only as instruments of *retention*, but also as levers for demographic rebalancing and the long-term sustainability of human capital. From this perspective, a cohort-based analysis would make it possible to observe the evolution of human capital and mobility along generational trajectories, distinguishing between age, period, and cohort effects, and assessing whether *brain drain* is a cyclical or structural phenomenon. Tracking cohorts, such as those born between 1980 and 1999, could allow researchers to estimate how different generations have contributed to the formation and loss of human capital in both origin and destination regions, highlighting intergenerational differences in the migration balances of qualified young people. Expected results suggest that younger cohorts exhibit higher migration propensities and stronger educational selectivity, thereby accentuating the territorial polarization of knowledge. The cohort approach also enables linking human capital loss to long-term demographic dynamics, showing how the outflow of qualified youth reduces not only the *current* endowment of competences but also the *future* capacity to regenerate them. In this sense, *brain drain* can be understood as a cumulative generational process, in which cognitive and demographic losses are transmitted from one cohort to the next.

5.5 Migration as a redistributive mechanism: a cross-cutting interpretation

To make explicit the common thread across the essays, I interpret the findings through three mechanisms (selectivity, territorial asymmetries, and policy signals) that jointly structure how mobility reshapes population, skills and age structure across space.

First, mobility is systematically selective. Migration decisions are not random with respect to age, education, or labor-market position. The first essay shows that institutional uncertainty alters destination choices in a skill-selective manner, with lower-educated individuals responding more strongly to anticipated policy restrictions. The third essay further demonstrates that selectivity is cumulative: positively selected outflows and uneven returns translate into persistent differences in per-worker human capital across territories. Selectivity thus acts as a multiplier, amplifying the demographic and economic consequences of mobility over time.

Second, migration interacts with pre-existing territorial asymmetries. Across all essays, mobility tends to reinforce center–periphery and North–South divides. In the second essay, internal migration concentrates working-age cohorts in dynamic urban areas, accelerating aging and demographic fragility in peripheral municipalities. In the third essay, the same spatial logic applies to human capital: stronger regions partially insure themselves against international losses by attracting talent from weaker areas, while the South experiences a double drain, both internal and external. Migration therefore contributes to convergence in some aggregate indicators, while simultaneously deepening structural territorial inequalities.

Third, policies and institutional signals play a decisive role in shaping these processes. The first essay highlights that migration responds not only to enacted policies but also to credible expectations and uncertainty. The second and third essays show that policy regimes governing labor markets, welfare, and

migration indirectly influence where working-age individuals and skilled cohorts concentrate, even when policies are not explicitly designed as spatial interventions. Taken together, the findings suggest that mobility is highly sensitive to institutional environments, and that policy design can unintentionally produce spatial spillovers and redistributive effects.

The next section summarizes these contributions and situates them within a broader demographic–economic reading of territorial mobility.

5.6 Conclusions

Taken together, the three essays demonstrate that mobility is not background noise in demographic and economic processes but a structural mechanism of redistribution that reorganizes people, skills, and age structures across space. Far from being a residual or contingent phenomenon, mobility emerges as a constitutive component of the Italian demographic system, one that responds to institutional signals, shapes territorial dynamics, and redefines the composition of human capital.

Each essay contributes to this overarching framework from a distinct yet complementary perspective: *i)* the first shows that migration decisions react not only to policies once implemented but also to the expectations generated by institutional uncertainty, as in the case of the Brexit referendum; *ii)* the second demonstrates that migration is a non-neutral factor of demographic convergence and divergence, capable of redrawing the geography of aging and widening territorial divides; *iii)* the third interprets the so-called brain drain as a selective and cumulative process of human capital reallocation, linking skilled mobility to the innovative and demographic regeneration capacity of regions.

From a methodological perspective, my thesis seeks to exploit the potential of integrated analyses combining administrative data, spatial modelling, and longitudinal approaches for studying population processes. Administrative data, despite their qualitative limitations, offer the territorial coverage and temporal continuity necessary to capture local heterogeneities. In my view, the integration of spatial and temporal dimensions is fundamental: migration cannot be interpreted as a punctual flow between locations, but rather as a continuous process embedded in networks of demographic, economic, and institutional interdependence.

Overall, the findings invite a reformulation of the study of mobility within a broader demographic–economic framework, suggesting that mobility interacts with aging, labor markets, and education systems, producing effects that are not immediately reversible. From this perspective, policies that influence mobility, whether incentives, restrictions, or place-based interventions, should be designed with a clear awareness of their anticipatory effects and spatial spillovers. Territorial mobility thus becomes both a symptom and a lever of regional change: on one hand, it reflects underlying structural imbalances; on the other, it provides potential channels for redistribution and adaptation.

At the theoretical level, the results challenge two traditional dichotomies: that between “push” and “pull” factors, and that between flows and stocks. In practice, the essays show that migration decisions are

determined as much by institutional expectations as by economic incentives, and that flows cannot be understood without reference to the population structures that shape them. In this sense, the stock–flow consistent approach proposed in the third essay represents an original contribution, bridging the gap between micro-level migration dynamics and macro-level structures of knowledge and skills.

From an applied standpoint, several lines of research and policy emerge:

- integrating demographic and migration data with functional indicators of human capital (skills, education–occupation matching, productivity) to measure the effective rather than formal redistribution of competences;
- extending analyses of demographic convergence to prospective indicators that account for longevity and the dynamic evolution of old-age thresholds;
- adopting a birth-cohort approach capable of tracing the intergenerational transmission of human capital and migration behaviors;
- exploring the existence of non-linear dynamics and critical thresholds (tipping points) beyond which local systems lose their cognitive and demographic regenerative capacity;
- assessing the compensatory role of skilled foreign migration, distinguishing quantitative substitution from qualitative equivalence in terms of competences and labor-market integration.

From a broader perspective, the thesis suggests that territorial imbalances cannot be addressed without understanding the mobility regimes that sustain them. Migration both reflects and reinforces inequalities, yet it can also represent a resource for renewal if governed coherently and with foresight. Recognizing mobility as a structural component of demographic and economic resilience is therefore essential to understanding and governing long-term territorial changes.

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