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1. INTRODUCTION

Migration has become increasingly important for regional development in Austria, the European Union, and many OECD countries due to demographic shifts characterized by declining birth rates and aging populations. This trend is anticipated to continue in the coming decades, which, combined with a reduction in the working-age population in many regions, highlights the critical role of migration in balancing demographic needs. Understanding where migrants settle, the impact they have on local economies, and the policies that shape these migration patterns is essential for addressing regional development challenges and ensuring sustainable economic growth. For policymakers, the importance of evidence-based data and scientific analysis on migrants' contributions at the local level is greater than ever. Addressing these issues requires detailed spatial data on migrant presence at both national and regional levels. Additionally, an in-depth analysis of regional vulnerabilities in relation to migration is essential to harness the full potential of migration. As social constructs evolve, the contrasting demographic rates between native and migrant populations, such as differing birth rates, aging patterns, and migration flows, underscore the urgent need for tailored and effective migration policies to manage population growth, decline, and structural shifts (OECD, 2022).

Austria presents a compelling case for studying migration trends for several reasons. Firstly, the country has a high proportion of foreign-born residents, which has exceeded 20% since 2020, ranking Austria fourth in the EU. Additionally, around 26% of Austria's population is estimated to have a migrant background. The presence of foreign-born individuals varies regionally, with Vienna, the capital, having the fourth-highest proportion of foreign-born people among all OECD regions. Vienna also saw the highest influx of migrants nationally in 2022, with an increase of 49,097 persons, whereas Burgenland (+3,318) and Vorarlberg (+3,308) recorded the lowest increases. Secondly, in Austria and other countries like the Czech Republic, France, Germany, and the Baltic states, the labor market gap is narrowing, with the employment rate of non-EU migrants increasingly approaching that of EU migrants. Despite consistently low birth rates, Austria's population growth has been driven by international migration, a trend that is expected to continue in the coming decades (OECD, 2022; Statistik Austria, 2023n).

Therefore, this thesis aims to study and answer two research questions:

1. How does migration contribute to population dynamics in Austria at national and regional level, and how do these contributions differ by country of birth (Austrian and foreign-born populations) in the period from 2002 to 2022?
2. How does the contribution of migration by country of birth varies across regions in Austria depending on their socio-economic vulnerability?

The basis for addressing the research questions lies in the application of Billari´s (2022) novel approach, which extends the demographic accounting methods by introducing the Population Turnover Rate (PTR) and the Migration Share of Turnover (MST). This approach challenges the common view that population dynamics are inherently slow and primarily determined by fertility and mortality rates. While this perception may hold true at the global level, migration movements can strongly influence local dynamics within nations, sub-national regions or municipalities. Consequently, population change also depends on the attractiveness and vulnerability levels of these areas. Demography is not a static phenomenon; it is dynamic and can change rapidly (Billari, 2022).

This study employs the PTR and MST methods as described in Billari's work, further expanding the application of these methods by distinguishing between internal and international migration, as well as between native and foreign-born populations. This approach aims to provide a granular analysis to improve the understanding of the impact of international migration in Austria at both national and regional levels.

The primary objective of this study is to conduct a holistic analysis of population changes from 2002 to 2022 by applying the PTR and MST, considering that native and foreign-born groups behave and influence population dynamics differently. Regional analysis is particularly relevant as migratory movements and settlement of the foreign and native-born populations are expected to vary across the country, leading to significant differences in migration's contribution to population turnover across Austria's regions. Additionally, recognizing that regions develop differently, these calculations are applied at regional level, incorporating socio-economic factors into a composite vulnerability index. To frame the results comprehensibly, a beta convergence regression including vulnerability as a condition, is applied to determine whether regions are converging or diverging towards a similar direction in terms to migratory movements.

To address the research questions, this thesis is divided into four sections. Chapter two, the literature review, provides an in-depth analysis by integrating historical migration patterns in Austria, the development of policy frameworks since 1960, migration trends in the foreign-born population in Austria and the scientific status quo on socio-economic regional studies. It also reviews Billari's results and other recent works employing the same method. This literature review enables a nuanced understanding of the complex nature of migration dynamics, better contextualizing the results achieved in the study.

Chapter three describes the data and methods used, detailing the various datasets utilized, sixteen in total, and necessary adaptations such as the harmonization process and data quality assessment. The methods section elaborates on the PTR and MST, as well as the decomposition of the MST, the creation of a vulnerability index, its relation to the MST and its components, and the beta convergence regression analysis of the Austrian regions.

Chapter four presents the study's results, starting with a descriptive analysis, followed by the vulnerability index results for the regions, and finally the convergence results. Chapter five discusses the results, contextualizing them based on the literature reviewed. Lastly, chapter six concludes with the main findings of the study, highlighting resulting research gaps and providing a future outlook for research.

To accurately interpret and understand migration statistics, it is crucial to consider the specific definitions used for statistical purposes. Migrants can be classified based on nationality, country of birth, migration background, or right of residence. Each definition offers distinct insights and perspectives on migration, but each also has its limitations (World Bank Group, 2023). While using nationality can accurately determine migrant status, this information is not always available in all databases. Consequently, the country of birth is often used as an alternative, providing a stable identifier that does not change over time. This approach categorizes foreign-born individuals as migrants for life, regardless of naturalization or cultural integration (World Bank Group, 2023). Analyzing migration by right of residence can be useful for public administration and policy, particularly concerning labor market analysis, although it may not fully capture the entirety of an individual's migration history.

Given the objective of this thesis to measure the contribution of migration to population changes in Austria, using the country of birth definition is appropriate. This definition offers a more accurate account for scientific exploration and a comprehensive understanding of the foreign-born population's impact on metrics such as the PTR and MST.

Since there is no universally accepted definition of the term "migrant" or specifically "foreign-born" in international law, this study adopts the definitions utilized by Statistics Austria. This approach is suitable, as most of the data used in this study is sourced from publicly available platforms by Statistics Austria. The definitions align with the guidelines set out in the “Recommendations for the 2020 Censuses of Population and Housing” by the United Nations Economic Commission for Europe (UNECE) (Expert Councli for Integration, 2023). According to Statistics Austria, a migrant is defined as a person who moves away from their primary place of residence, which may occur within the country (internal migration) or across international borders. The foreign-born population comprises individuals who have migrated at least once in their lifetime and reside outside their country of birth. Those born in the country where they currently reside are classified as "native-born". Furthermore, a person with a "migration background" is defined as having both parents born abroad, which can be further categorized into first-generation (individuals born abroad) and second-generation (individuals born in Austria to parents who were born abroad) (Expert Councli for Integration, 2023; Statistik Austria, 2023j).

This study also recognizes that statistics are used to simplify and categorize the complexity of the world, rather than as a direct reflection of reality. This can be seen in the different ways in which certain groups such as ethnic minorities, religious groups or immigrants are counted in global censuses and databases. The historical challenges of accurately counting and recording population groups, including migration, date back to the 19th century. Considerable resources have been invested in recording and categorizing different population groups in order to better understand and manage demographic changes (Fassmann et al., 2009).

The relevance of this study is multifaceted. First, it advances the scientific understanding of how migration shapes Austria's population and is related to the socio-economic vulnerability of regions. While there are available studies on the vulnerability of European regions and convergence, this research uniquely integrates these aspects in relation to migration - a perspective that has not been explored for the Austrian case before, according to the current

knowledge. Second, it provides policy makers with an empirical analysis of migration movements, particularly in the context of EU cohesion policy, which aims to address inequalities between EU regions and underlines the urgent need for effective cohesion policy.

Furthermore, this work is part of the Horizon Europe project PREMIUM_EU (Policy Recommendations to Maximize the Beneficial Impact of Unexplored Mobilities in and Beyond the European Union, Grant Agreement 101094345 - AMD-101094345-3), which aims to investigate the impact of migration and its contribution to the development of vulnerable regions in Europe, with Austria serving as one of the case studies[1].

[1] https://premium-eu.org/about-us/

2. LITERATURE REVIEW

To address the research questions outlined in the introduction, this literature review provides a comprehensive overview of relevant scientific publications. It covers the historical migration events in Austria, the evolution of migration policies over time, and the latest published statistical data and analyses on international migration in the country. Additionally, the review examines demographic trends, socio-economic development, and vulnerability in Austria. This approach offers a deeper understanding of the complex dynamics of migration, providing essential context for the methods and analyses applied later in the thesis.

2.1 A SHORT SUMMARY OF MIGRATION HISTORY IN AUSTRIA

Migration and mobility have fundamentally impacted human history, shaping societies through diverse movements across cultural, political, and natural borders. Historically, migration has been driven by forces such as the state, empires, and economic interests, particularly evident since the Atlantic slave trade and the industrial revolution in Europe. Unlike the binary concept of emigration and immigration, migration involves a broad spectrum of movements, both within and between countries. These movements can be temporary or permanent, voluntary or forced, reflecting a wide array of human experiences and motivations (Colic-Peisker, 2017).

To effectively contextualize contemporary migration events in Austria and within the observation period (2002 to 2022), it is relevant to revise the country's migration history. This examination helps elucidate the current the demographic makeup of the country. Furthermore, understanding migration history is vital as it uncovers how historical narratives are used in current public discourses and shapes societal perceptions of migration (Bertossi et al., 2021).

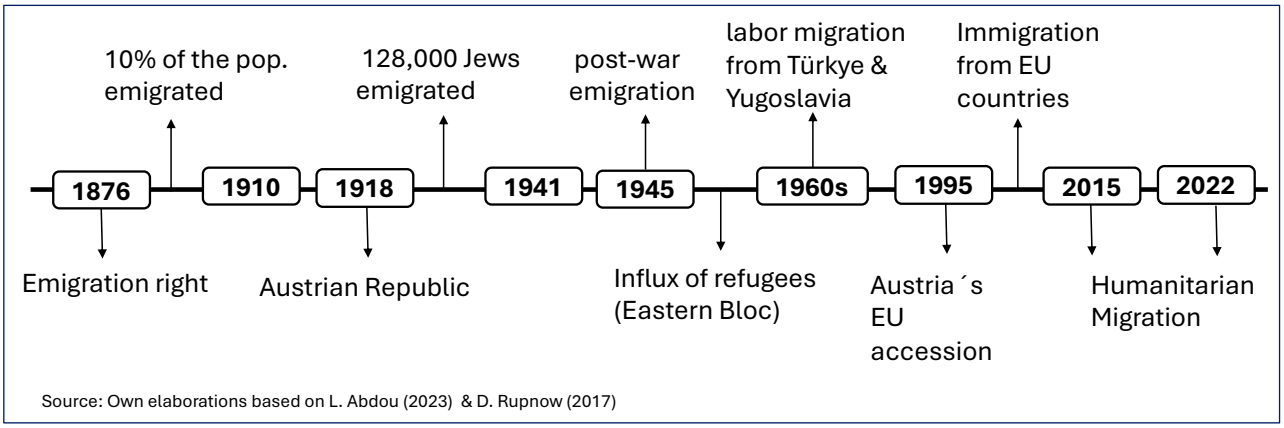
As shown in the timeline in Figure 1, which outlines key migration events that have influenced Austria's population dynamics over time, migration is not a new phenomenon. In fact, the Habsburg Empire experienced significant internal population movements in the 19th century due to industrialization and urbanization. In 1876, emigration, once strictly regulated, was permitted, which led to significant international emigration in the following decades: 10% of the population emigrated between 1876 and 1910 (Hadj Abdou, 2023).

The interwar period saw further emigration, exacerbated by economic depression and political instability. Annexation by Nazi Germany in 1938 triggered mass Jewish emigration, followed by a tragic loss of life during the Holocaust. Post-war Austria remained primarily a country of emigration, the main motives were the desire for economic and political security, which was not seen in Austria until 1955, destination countries were the United States of America, Canada, Brazil, South Africa, and other European countries (Horvath & Neyer, 1996).

In the 1960s, Austria developed guest worker programs ("Gastarbeiter Program") recruiting migrant workers from Turkey and Yugoslavia, marking the beginning of its transformation into a country of immigration. Prior to this period, emigration was more impactful even though immigration and internal migration were also occurring (Rupnow, 2017).

The 1973 the oil crisis led to stricter immigration controls and shifted the emphasis to permanent immigration, particularly through family reunification. The end of the Cold War brought a new influx of migrants, including those fleeing the conflict in Yugoslavia. Austria's accession to the European Union (EU) in 1995 led to a further increase in immigration from member states. The humanitarian crisis highlighted the importance of Austria as a destination country for asylum seekers in Europe. Despite fluctuations, humanitarian migration remains significant. Austria has received a significant number of asylum applications in recent years, including a spike in 2022 due to the conflict in Ukraine (Hadj Abdou, 2023; Rupnow, 2017).

Figure 1: Migration History of Austria
Timeline from 1876 until 2022

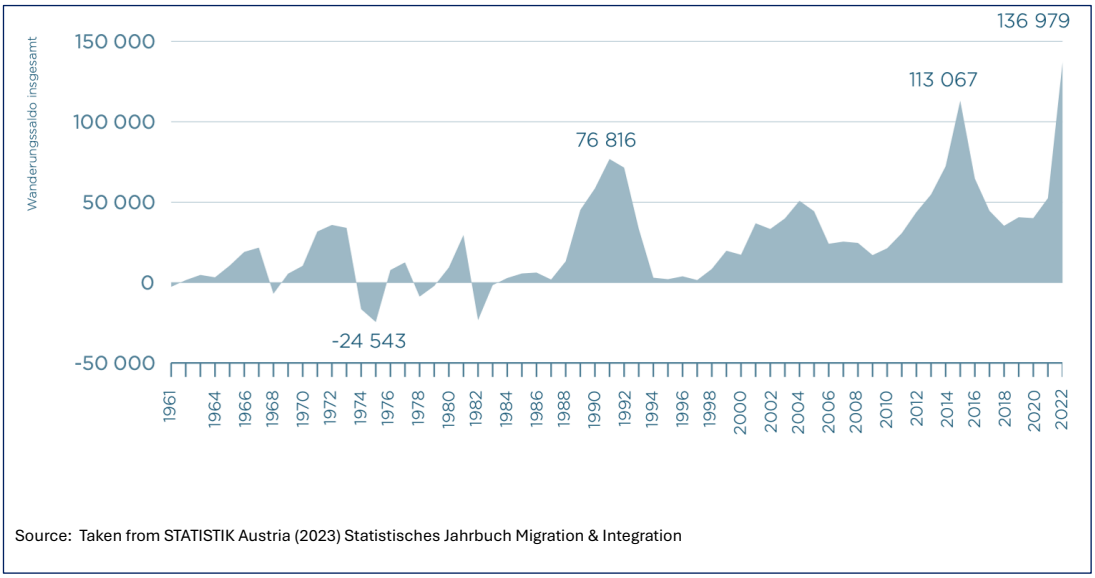


Source: Own elaborations based on L. Abdou (2023) & D. Rupnow (2017)

This brief migration history of Austria is reflected in the net migration statistics published by Statistics Austria, spanning from 1961 to 2022 (Figure 2). The data shows that net migration in Austria fluctuated at relatively low levels from 1961 to 1988, ranging from around 48,000 persons

in 1970 to a low of -24,543 persons in 1975. After 1988, the graph indicates consistently positive net immigration, with notable peaks around 1991, 2015, and 2022, influenced by surges in refugees from the former Yugoslavia, Syria, Iraq, and most recently, Ukraine. There was also a significant peak in 2004, linked to the EU enlargement. Net migration reached its highest point in 2022, with 136,979 net immigrants (Statistik Austria, 2023n). The chart clearly illustrates that Austria has experienced positive net migration throughout the 21st century. Evidently, significant historical events have left a notable impact on Austria's net migration patterns.

Figure 2:Net international migration in Austria
Timeline from 1961 until 2022



Source: Taken from STATISTIK Austria (2023) Statistisches Jahrbuch Migration & Integration

In demographic detail, the proportion of foreign nationals in 1961 was merely 1.4%. This figure escalated to 4.1% by 1974, influenced by the recruitment of "guest workers" from Yugoslavia and Turkey. The upheavals of the Yugoslav wars in the 1990s further increased the foreign population in Austria to over 8% by 1993. Following the turn of the millennium, the rate climbed over 10% in 2008, with about 845,000 people out of a population of 8.3 million. The influx continued, and by 2015, Austria recorded more than 88,000 asylum applications, mainly from Afghanistan, Syria, and Iraq, resulting in Austria having the second highest per capita rate in Europe with 10 asylum seekers per 1,000 inhabitants after Sweden (17 per 1,000 inhabitants) (Biffl, 2024; Rupnow, 2017).

2.2 DEVELOPMENT OF MIGRATION POLICIES IN AUSTRIA SINCE 1960

The historical migration dynamics discussed earlier align closely with the development of Austria's migration policies. Between 1914 and 2014, around 150 migration policy changes were documented in Austria, as detailed by de Haas et al. (2015). A comprehensive list of these policies and their dimensions is available in the DEMIG Policy Database (Schreier et al., 2023). Notably, Fassmann & Reeger (2008) systematically conceptualized and organized the most relevant migration policies for Austria from 1960 to 2005, segmenting the evolution of these policies into three distinct phases: “initial,” “intermediate,” and “new stability.”

Each phase identified by Fassmann & Reeger (2008) is marked by specific migration patterns, characteristics of the migrant population, and their geographical origins. Table 1 provides an overview of this framework, highlighting the strategic shifts in Austria's migration policy approach. Understanding these shifts necessitates revisiting the definition of migration policies. While there is no universally accepted definition, Bjerre et al. (2015) offer a comprehensive synthesis, defining migration policy as a government's stated intentions and actions, including laws and decisions, regarding the selection, admission, settlement, and deportation of foreign nationals. This definition provides a foundation for exploring the three migration policy phases as described by Fassmann & Reeger (2008), which will be further elaborated upon with additional literature.

The initial phase of Austria's migration policy, spanning from 1960 to 1973, was predominantly shaped by economic needs and labor demands from the private sector. Emulating models previously established by other European nations, Austria focused on "guest-worker" migration agreements with specific origin countries, Turkey and Yugoslavia. Under the "Raab-Olah Agreement" of 1962, quotas were established that allowed employers to hire foreign workers without the requirement to demonstrate the unavailability of Austrian nationals for these positions, a requirement stipulated by a 1933 law. The “guest-worker” migration policies were designed around the concept of circular migration, with the expectation that foreign workers would return to their home countries after their employment period in Austria, attracting mainly male workers who were unemployed in their country of origin or sought financial stability. Additionally, this period marked the introduction of the first Asylum Act in Austria in 1968, setting the legal framework for the treatment and processing of asylum seekers (Fassmann & Reeger, 2008).

The intermediate phase from 1973 to 1993, was influenced by two historical events that shaped the migration policies in Austria, the economic stagnation triggered by the oil crisis in 1973 and the influx of the baby-boom generation into the labor market eliminating the previous labor shortages. As a result, between 1974 and 1976, Austria made significant efforts to reduce its foreign labor force, effectively halting official recruitment. This policy shift exposed the inadequacies of the rotation principle, instead, many chose to settle permanently in Austria and opt for family reunification options. This marked a move toward more permanent forms of migration, contrary to the initial political goal of temporary labor migration, with the introduction of the Aliens Employment Act in 1975 and the Residence law in 1993 (Fassmann & Reeger, 2008). During this phase, migration became a more prominent and politicized policy field, particularly highlighted by the Freedom Party of Austria (FPÖ). In 1992, the FPÖ popularized the slogan "Austria first," emphasizing a nationalistic approach to migration policy. With the residence law a differentiation between EU and non-EU nationals was implemented and a quota system was introduced for third-country nationals, requiring them to have residence permits and evidence of subsistence and accommodation, before moving to Austria, implying that they needed a guaranteed job prior to immigration. First-time immigrants could initially stay for six months, extendable up to two years, but losing employment or housing could lead to expulsion. The quota system was utilized until 2011 deemed successful in reducing the number of foreign nationals. Net migration decreased sharply after 1992 and gradually increased again with Austria's EU membership and Eastern EU enlargement (Fassmann & Reeger, 2008; Kraler, 2012).

The third phase, starting in 1994 and continuing to the present, is marked by more systematic policymaking aligned with EU regulations and objectives, in this phase immigration policy in Austria shifted from a quota system that became irrelevant over time towards a point system. This began with the implementation of the 1997 “Integration package” with the aim of focusing on integration of foreigners already living in Austria, while discouraging new migration. Shortly thereafter, the amendment of the Naturalization Act (1998) came into effect. This amendment retained previous requirements, such as acquiring Austrian nationality through an Austrian parent and maintaining permanent residence in the country for ten years. Additionally, it introduced German language and historical-cultural examinations, and applicants were required to demonstrate financial coverage, ensuring they did not require social benefits from the state (Biffl, 2012; Fassmann & Reeger, 2008; Kraler, 2012).

In July 2002, the Austrian parliament amended the Aliens Act of 1997 to align with EU directives. This amendment introduced a 'residence certificate' to harmonize residence and employment rights. It brought three key changes: ending labor immigration for unskilled workers by abolishing the employee quota and retaining it only for highly skilled migrants. Secondly, it facilitated the employment of seasonal workers, allowing their recruitment across more industries, extending their employment period up to one year, and introducing a quota for key workers to attract highly qualified third-country nationals, and thirdly requiring all third-country nationals to sign an "integration agreement" (Fassmann & Reeger, 2008; Kraler, 2012)

In 2005, the government further revised the alien's legislation with the "Foreign National Legislative Package" to implement EU directives into national law, diversify the migration legal landscape, and enhance state control over irregular migrants. This reform maintained restrictive new immigration policies and increased integration requirements. The residence law was annually fixed, coordinating with parliamentary committees and social partners, and subdivided into quotas for federal states and specific purposes like family reunification and key personnel. Later in 2008, the Austrian government recognized the need for legislative reforms to address skill shortages that the national education system could not fulfill adequately. This led to the introduction of the new Foreign National Legislative Package in 2011. A significant feature of this package is the Red-White-Red Card (RWR) which replaced the previous quota-based system to focus on "key workers." The RWR Card implements a point-based immigration system designed to provide a more flexible approach to the immigration of qualified third-country workers and their families. This system evaluates applicants based on personal and labor market criteria, facilitating their permanent settlement in Austria (Biffl, 2023).

Between 2011 and 2020, several key migration policies were implemented in Austria, a significant development was the establishment of the Federal Office of Asylum and Migration in 2014, which marked a centralized approach to managing asylum procedures. From 2016 onwards, regulations were introduced to set quotas on asylum applications, accompanied by various amendments over time, including the introduction of temporary border controls. Furthermore, around 2017, the coalition government of the Austrian People's Party (ÖVP) and the Freedom Party of Austria (FPÖ) enacted stricter measures on residence permits and citizenship acquisition, reflecting a tightening of migration controls. Simultaneously, migration policies were also designed to address labor

shortages by implementing an annual publication starting in 2019 that identifies occupations classified as “shortage occupations.” These policies included targeted measures to enhance the employability of third-country nationals, particularly those with international protection status and women with a migration background. The initiatives focused on providing language training, retraining programs, and skills assessments to facilitate integration into the labor market and meet the specific demands of Austria's economy (Schreier et al., 2023).

Table 1: Overview of Austrias Migrations policies over time

Phase	Period	Policies & Laws	Migration Patterns	Characteristics of the migrant population	Place of Origin
Initial	1960-1973	Contingents for guest-workers “Raab-Olah-Agreement” (1962) Agreement with Turkey (1964) & Yugoslavia (1965) Asylum Act (1968)	Immigration surpasses emigration, with focus on circular and temporary migration and fluctuations.	Labor-demand driven migration, mainly male dominated	Regions of origin shifted from Northern areas of former Yugoslavia to Serbia and Montenegro
Intermediate	1973-1993	Aliens Employment Act (1975) Adaption of Asylum Act (1991) Residence Law (1993)	More balanced migration, dominated by traditional guest worker countries. Shift from male labor migration to family unification	Transition from male-dominated migration to family reunification	Turkey
New Stability	1994-2005	Integration Package (1997) Revisions: 1991 Asylum Act (1997) & Aliens Law Package (2005)	Immigration remains constant, with EU accession increasing intra-EU migration.	Migration of young workers (15–35 age group) balanced male and female migration	Diversification of regions of origin; declining significance of traditional guest worker countries

Source: Adapted from Fassmann & Reeger (2008)

The reviewed literature on Austria's migration history and policy development highlights a marked transition from being a country shaped mainly by emigration movements previos to 1950 to one of immigration since 1960. The development of migration policies has undergone several phases characterized by two main trends: from the 1960s to 2011, policies were primarily quota-based, while from the early 2000s onwards, there has been a shift towards the Europeanization of migration policies, culminating in the adoption of a point-based system.

Austria's official stance on not been classified as a “migration country” has significantly shaped its immigration policies and integration strategies, leading to stricter regulations and increased migration controls. This stance is reflected in restrictive measures that limit traditional labor migration and family reunification programs, largely a response to public dissatisfaction with immigration in the early 1990s and in recent years. While Austria has implemented new integration initiatives and adapted to EU accession by allowing more open borders and the admission of temporary seasonal workers, its policies still reflect an ambivalence towards fully embracing its role as a country of immigration (Biffl, 2023; Fassmann et al., 2009). Whether Austria shall be defined as a migration country continues to be a contentious issue in Austrian political discourse (Rupnow, 2017).

2.3 RECENT MIGRATION TRENDS IN THE FOREIGN-BORN POPULATION IN AUSTRIA

This subchapter revises recent reports analysing migration statistics based on data from Statistik Austria, which is the official body responsible for compiling, processing, and disseminating statistical information about Austria's economy, population, and society, using data collected through censuses, surveys, and administrative records. Additionally, it references the 47th report of the OECD's Continuous Reporting System on Migration (2023), which provides an overview of recent international migration trends and examines the integration of immigrants into the labor market. This report includes country-specific notes, statistics on migration movements,

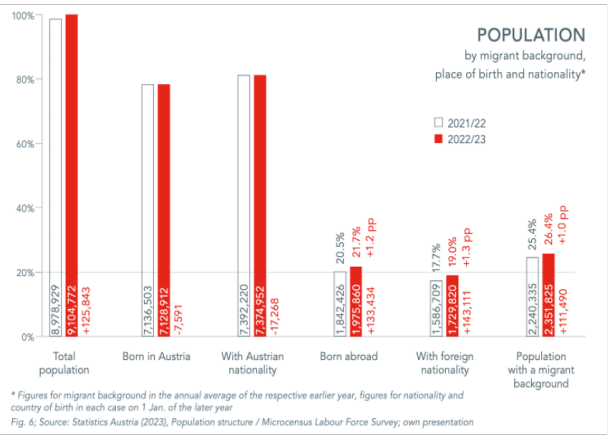
As highlighted in the historical overview and the evolution of migration policies, Austria has emerged as a key destination for migrants over the past decades, with the foreign-born population exceeding 20% since 2020 (Statistik Austria, 2023o). This significant rise in migration has positioned Austria among the top OECD countries with the highest ratios of foreign-born population. Between 2012 and 2022, the share of foreign-born residents increased in nearly all OECD countries, with more than two-thirds having a foreign-born population accounting for over 10% of their total population. In 2022, Austria ranked sixth among OECD countries, with a foreign-born population making up 21%, a 2% increase from 2012, closely following Canada at 22% (OECD, 2023).

According to the Integration Report 2023 for Austria, the population grew by 125,843 between 2022 and 2023, reaching a total of 9.1 million, up from 8.9 million the previous year. During this period, the population's composition by place of birth included 7.1 million individuals born in Austria and 1.8 million born abroad (Figure Nr 3, a). The report also indicates a slight increase in the percentage of the population with a migrant background, which rose to 26.4% in 2022-2023, representing an additional 111,490 individuals compared to the previous period (Expert Councli for Integration, 2023).

Figure Nr 3,b, further illustrates that in 2023, most first-generation immigrants were from Germany, Eastern European countries, the Western Balkans, Syria, Afghanistan, the Russian Federation, and other regions (Expert Councli for Integration, 2023).

Figure 3: Population in Austria with focus on immigrant population

a. Population by migrant background, place of birth and nationality



b. Immigrant Population (First Generation) by most common countries of birth

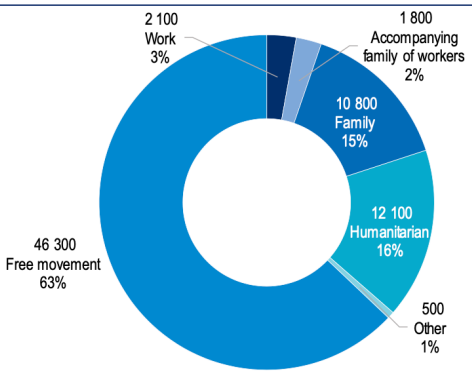
	2013		2023
Germany	205,868	Germany	258,550
Türkiye	159,185	Bosnia and Herzegovina	176,736
Bosnia and Herzegovina	151,705	Türkiye	161,122
Serbia	130,862	Romania	145,033
Romania	73,904	Serbia	144,276
Poland	63,242	Hungary	88,866
Hungary	48,137	Ukraine	80,417
Czechia	41,618	Poland	77,119
Croatia	39,005	Syria	73,931
Slovakia	29,963	Croatia	56,455
Russian Federation	29,420	Slovakia	47,034
Kosovo	28,150	Afghanistan	44,918
Italy	26,181	Russian Federation	40,532
Other	337,531	Other	580,871
Total	1,364,771	Total	1,975,860

Fig. 7; Source: Statistics Austria (2023), Population at the beginning of the year detailed by country of birth; own presentation

Source: Taken from Expert Council for Integration (2023) Integration Report 2023

Furthermore, regarding the purposes of migration, Austria welcomed 74,000 new long-term or permanent immigrants in 2021, marking a 17% increase from the previous year. This increase was mainly driven by free mobility within the EU, which accounted for nearly 63% of all immigrants. Humanitarian migration followed, making up 16% of the total, while family reunification accounted for 15%, as illustrated in Figure 4 (OECD, 2023).

Figure 4: Long-term international immigration flows Austria, 2021



Source: Taken from OECD (2023) International Migration Outlook 2023

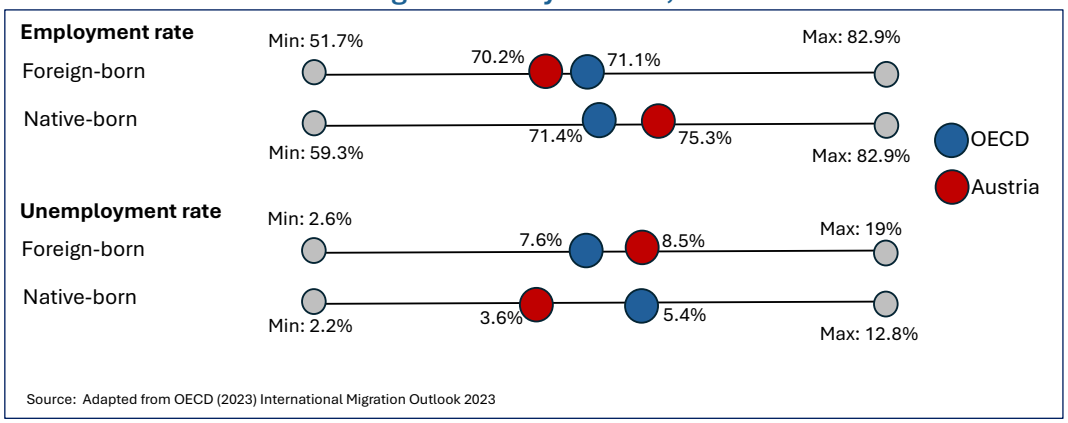
Austria's experience with migration under the free-mobility scheme within Europe reflects a broader trend seen across many OECD countries, where migration has become a vital factor in demographic and economic growth. In 2022, several key European destinations experienced substantial increases in intra-european inflows, including Switzerland (+20%), Denmark (+19%), Austria (+16%), Sweden (+29%), and Ireland (+38%). These increases highlight the interconnected nature of European economies and the significant influence of EU free movement policies (OECD, 2023).

Humanitarian migration has significantly shaped Austria's migration profile, with the number of humanitarian migrants more than doubling since 2019. Between 2019 and 2022, Austria ranked seventh among OECD countries for the highest number of new asylum applications, following the United States, Germany, France, Costa Rica, Mexico, and Spain, but ahead of Canada and the United Kingdom. In 2022, Austria received approximately 106,000 first-time asylum seekers, a 180% increase from the previous year, with the majority coming from Afghanistan, India, and Syria. This high number of asylum seekers per capita—over 10,000 asylum seekers per million inhabitants—places Austria among the top OECD countries in terms of asylum seekers relative to population size. These figures reflect the broader migration dynamics driven by political and economic instability in the applicants' home countries (OECD, 2023).

In addition to humanitarian migration, Austria's approach to labor migration aligns with broader trends within the OECD. To address labor shortages, Austria increased its seasonal worker quota by about 30% in 2022. This proactive strategy is consistent with measures taken by other OECD countries, such as France and Norway, which have also significantly expanded their intake of

seasonal workers. The focus on attracting seasonal labor highlights Austria's efforts to fill workforce gaps in specific sectors, a challenge that many developed nations face. Employment statistics for the year 2022 further illustrate these dynamics (figure 5); the employment rate for native-born individuals in Austria is 75.3%, slightly higher than the 70.2% rate for foreign-born individuals. Both rates are above the OECD average of 71%. However, there is a notable disparity in unemployment rates: native-born individuals have an unemployment rate of 3.6%, compared to 8.5% for foreign-born individuals (OECD, 2023).

Figure 5: Employment & Unemployment Rates in Austria According to country of birth, 2022



Regarding regional migration developments, Austria's nine federal provinces exhibited notable differences in net migration patterns in 2022. Vienna led with a net increase of 49,097 international migrants, accounting for 35.8% of Austria's total. Other provinces with significant international net migration included Lower Austria (+19,816), Upper Austria (+17,897), and Styria (+16,983), while Burgenland (+3,318) and Vorarlberg (+3,308) had the lowest figures. In terms of internal migration, Lower Austria saw the highest net gain from other provinces, with an increase of 4,751 people, followed by Burgenland and Vorarlberg. Conversely, Tyrol, Styria, Carinthia, and Salzburg experienced net losses. Overall, internal migrations totaled 842,152, a 7.6% rise from 2021, with most moves occurring within the same municipality (52.8%) and 17.1% involving relocations between different provinces. (Statistik Austria, 2023o).

2.4 UNDERSTANDING THE SPEED OF DEMOGRAPHY

The presented migration history of Austria and Austria´s current migration trends, based on national and international reports, highlight the central role of migration in shaping the country's present and future population dynamics. To address the pivotal role of migration this research examines Francesco Billaris recent work “Demography: Fast and Slow” (2022) and also revises the poster by Damoun et al. (2024), which applies the same methods to the Spanish case.

In his paper, Francesco Billari argues for a deeper understanding of "rapid demography", in which migration plays a central role, especially in countries like Austria that have completed the demographic transition. Billari uses the Population Turnover Rate (PTR), which is determined by births, deaths and migration, and focuses on migration movements through the Migration Share of Turnover (MST). The PTR, a concept widely applied other disciplines such as biology, encompasses the universal processes of births, deaths and migration to measure population change. Billari contends that demographic change can be both slow and fast. At the global level, declines in mortality and fertility have decelerated population change, but at the country level, changes can be rapid, especially in affluent post-transition societies. Billari's analysis, which includes detailed case studies of Italy and Germany from 1915 to 2020 as well as global PTR and MST trends on six continents (Africa, Asia, Europe, Latin America and the Caribbean, North America and Oceania) at five-year intervals from 1990 to 2020, highlights this phenomenon (Billari, 2022).

His findings reveal that the global PTR, has more than halved from 56 per 1000 in the 1950s to 26 per 1000 in recent years due to declining birth and death rates. In Europe, the average country-level PTR rose slightly from 37.9 to 39.5 per 1000, while in Africa it fell from 67.1 to 47.6 per 1000 over the same period. The impact of migration on demographic change is evident: the MST increased from 27.6% (for 1990-1995) to 32.2% (2015-2020) globally and from 35.8% to 45.0% in Europe. Furthermore, the paper also shows that as countries develop (measured by HDI), their population turnover rates initially decrease but then stabilize and migration plays an increasingly important role in this dynamic, especially in highly developed countries (Billari, 2022).

Specific results for Germany and Italy show how historical events like World Wars I and II, technological advances such as the contraceptive revolution, and policies aimed at demographic processes strongly influence PTR and MST. In recent years, Italy's PTR has fluctuated due to the 2008 economic recession, the COVID-19 pandemic, and mass international migration, moving

from 33.1 per 1000 in 2008 to 25.5 per 1000 in 2020. The MST in Italy peaked at 41.4% in 2007 but fell to 24% in 2020, the lowest point since 2001. For Germany, recent results show that until 2006, the PTR was declining, reaching 34 per 1000 due to low fertility levels. However, due to the influx of humanitarian migration resulting from the civil war in Syria, PTR levels increased to 59.8 per 1000 in 2016. The MST also shows an increase from 2010 onwards, rising from 48% to 65% in 2016, before declining to 55% in 2020 due to the COVID-19 pandemic (Billari, 2022).

Based on the empirical findings the paper concludes that the "slow demographic" perspective is insufficient for understanding the changes at country level. A "fast demographic" approach, using up-to-date data from digital sources and regular monitoring, is needed. Demographic theories should focus more on migration flows and the speed of population change. Long-term population projections based on slow demographics can be misleading due to uncertainties, especially in migration. A fast demographic perspective recognizes that population change is influenced by various factors that need to be considered together (Billari, 2022).

To study the Spanish case, Damoun et al. (2024) calculated the PTR and the MST for the period 2002-2022 at a national and regional level. They also developed a vulnerability indicator that includes three dimensions: the social, demographic and economic dimensions, each dimension consisting of three specific indicators. The authors examined the relationship between the vulnerability indicator and the components of MST in population development. In addition, a convergence regression was applied to the regions, using vulnerability as a condition to assess whether the MST components converge or diverge between regions.

The results for the Spanish case show a fluctuating PTR and MST for the period 2002-2021, with the PTR fluctuating between 32 and 46 per 1000 inhabitants, peaking in 2007 and 2018 and falling in 2012 and 2020. The MST fluctuates more and ranges from 39% to 62%. Regions with low to medium vulnerability tended to have higher MST over time than regions with medium and high vulnerability. The authors conclude that international migration of foreign-born individuals is the main driver for population change. The convergence regression results indicate that regions with lower initial levels of population turnover experience higher growth, confirming the trend of rapid demographic change. Vulnerable areas in Spain are facing increasing depopulation, while less vulnerable provinces are growing, making the analysis of migration crucial (Damoun et al., 2024).

2.5 RECENT SOCIOECONOMIC DEVELOPMENT IN AUSTRIA

As demonstrated by Damoun et al. (2024) and Billari (2022), migration dynamics significantly interact with various dimensions of socioeconomic development. Whether international or national, migration is a crucial component of population changes, both influencing and being influenced by economic development. Economic development acts as push and pull factor for labor mobility, shaping migration patterns. In turn, migrants impact their origin and destination countries and national regions through remittances, labor force participation, and contributions to economic growth. Changes in migration can affect income levels and distribution within and between national regions. Therefore, regional socioeconomic development paths must explicitly consider migration patterns and regional cohesion (Benveniste et al., 2021).

Regional cohesion has gain prominence at European level over recent decades largely due to Article 158 of the EU Treaty, which emphasizes in reducing disparities between regional development levels. These disparities are seen as detrimental to the EU's competitiveness, integration, and cohesion. Consequently, the EU's cohesion policy, which is the primary instrument for addressing regional disparities, allocates substantial funds to support lagging regions, aiming to help them converge with more prosperous areas. Research indicates a trend toward reduced inequalities among EU member states over the past decades, earning the EU a reputation as a "convergence machine" up until the global financial crisis in 2008. However, despite these efforts, disparities within individual countries have been increasing, exacerbated by the 2008 financial crisis and the accession of new member states. By 2017, within-country disparities accounted for 66% of total EU inequalities, compared to one-third in 2000 (López-Villuendas & del Campo, 2024).

When it comes to understanding cohesion policy, the EU desings it as to meet a broad array of goals, including boosting economic growth, enhancing competitiveness, increasing employment, promoting social inclusion, ensuring environmental sustainability, and fostering innovation. It seeks to achieve these goals throughout all EU regions, not only in the most vulnerable areas, despite varied local conditions (Crescenzi & Giua, 2020).

In accordance with the most recent EU Joint Research Center (JRC) science for policy report on European Territorial Trends (Lavalle et al., 2017) and considering the OECD Better Life Index, which

developed economic indicators to measure social and economic progress in OECD countries, this thesis examines the following socio-economic indicators for Austria in detail to later formulate a vulnerability index of the regions with empirical data: the economic dimension includes GDP per capita, GDP growth per capita, and the unemployment rate; the social dimension encompasses tertiary education level and life expectancy at birth; and the demographic dimension covers the population growth rate, the share of the population aged above 65 years, and population density. These indicators provide a comprehensive analysis of Austria's socio-economic and demographic trends.

In terms of economic development, Austria's national economic performance reflects a highly developed and stable economy, characterized by a high GDP per capita, ranking among the highest in the OECD (OECD, 2024). Despite a significant GDP decline of 6.7% in 2020, primarily due to a downturn in tourism amid the COVID-19 pandemic, the economy showed resilience. Government support measures to protect businesses and boost consumer spending facilitated a recovery, with the economy rebounding to pre-pandemic levels by the third quarter of 2021. Over 2021, real GDP grew by 4.5% (European Commission, 2022a). Additionally, projections from the JRC report suggest a continued strong and uniformly distributed GDP per capita across Austria (Lavalle et al., 2017).

However, this national prosperity masks significant regional disparities. Vienna, as Austria's economic center, consistently reports higher GDP per capita, driven by its concentration of services and international businesses. Similarly, Upper and Lower Austria benefit from strong industrial sectors, contributing significantly to economic growth. In contrast, rural regions like Burgenland and Carinthia experience lower GDP figures, reflecting less industrial activity and economic diversification (OECD, 2024).

Austria also presents low unemployment levels In 2020, the unemployment rate surged to 10% due to the COVID-19 pandemic, the unemployment rate in Austria rose to 8.4 % for nationals (compared to 6.4 % in 2019) and to 15.3 % for foreigners (compared to 10.8 % in 2019). In Austria, this rate is based on the share of registered unemployment in the total labor force (excluding the self-employed In 2020, The EU-wide harmonized unemployment rate, which is derived from the Labour Force Survey, rose from 4.5% in 2019 to 5.4%. The unemployment rate of foreign workers was more than twice as high as that of domestic workers (11.5% compared to 4.0%). Despite this

increase, Austria's unemployment rate remained below the EU average of 7.1%. In particular, some Central and Eastern European countries as well as Germany (3.9%) and the Netherlands (3.8%) had lower rates. However, economic recovery in 2021 led to an improved employment situation, with the unemployment rate dropping to 8% and labor force participation rates remaining high at 77%. As the economy continues to grow, labor shortages are becoming more apparent, affecting both high-skilled professions and lower-skilled sectors such as services and tourism, potentially limiting economic progress (Biffl, 2023; European Commission, 2022a).

In the social dimension, Austria shows a positive development overall. The proportion of adults with a tertiary education has risen steadily from 38.6% in 2015 to 41.4% in 2020. Life expectancy at birth has also risen steadily, from 81.3 years in 2015 to 82.0 years in 2019. During the COVID-19 pandemic, however, life expectancy fell to 81.3 years. By 2022, the average life expectancy at birth in Austria had risen again to 82.1 years. Over time, life expectancy in Austria has always been higher than the EU average (European Commission, 2022a).

The demographic dimension reveals the significant impact of international migration on population growth in Austria. According to the analysis by Biffl (2023), over the last 30 years, demographic changes in Austria have been driven primarily by migration, including labor and family migration, free movement of EEA/CH citizens and refugee flows. Natural population growth had only a minimal impact until the influx of refugees in 2014/16, which significantly increased population growth due to the high birth rates among the refugees. The strong population increase in 2015 and 2016 was mainly due to the large influx of refugees and the dynamic immigration of EU citizens from the new member states. Since 2009, population growth in Austria has been almost exclusively due to immigration, although the ratio of births to deaths was positive from 2009 to 2021.

Furthermore, due to Austria's ageing population, the number of people of working age (20 to 65 years) is expected to fall by almost 300,000 by 2040, which corresponds to a 5% decline in the working population compared to current levels. In addition, the number of older Austrians (65 years and older) is expected to increase by more than 60% over the next 50 years. As a result, the ratio of older people to people of working age is expected to increase from two pensioners per person of working age to around three pensioners per person of working age over this period (European Commission, 2022a).

2.6 SOCIO-ECONOMIC VULNERABILITY AND CONVERGENCE

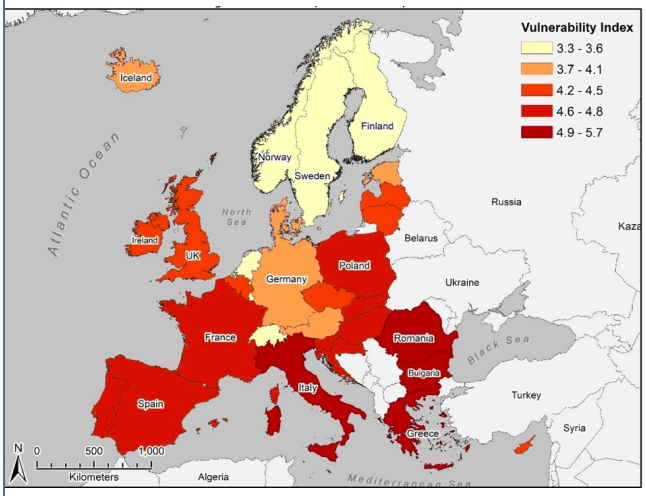
Building on Austria's economic, social, and demographic dimensions presented earlier, it is evident that the country is highly developed and resilient, with international migration significantly contributing to population growth. Despite challenges such as the COVID-19 pandemic and an aging population, Austria has demonstrated an ability to recover and adapt, maintaining low unemployment rates and high life expectancy.

At national level, the European Commission classifies Austria's socio-economic vulnerability as medium-low and capacity as medium-high, reflecting improvements in recent years, particularly in reducing gender gaps in employment and the unemployment rate. However, vulnerability related to public debt remains medium-high. Some capacity indicators have deteriorated compared to the previous year, including the impact of social transfers on poverty reduction, the household savings rate and the ratio of government investment to GDP. On the other hand, there were improvements in the employment rate, active labor market measures per person willing to work and the absolute number of healthy life years at birth (European Commission, 2024).

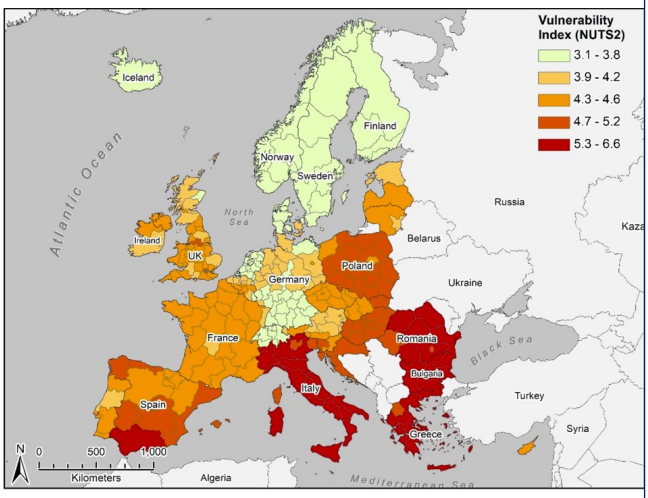
In line with the socio-economic dimensions affecting vulnerability at a national level mentioned for the European Commission (2024 study), the JRC develops a vulnerability index based on four dimensions: social, economic, environmental and political, and applies it at both country and NUTS 3 level. Figure 6 shows a comparison at a European level of the vulnerability index at national level (graph a), where Austria has a medium to low vulnerability level, similar to Germany, Iceland and Estonia, and higher than the Nordic countries, the Netherlands and Switzerland. At the NUTS 2 level (federal states) graph b, differences can be observed within the national scale. The scale used to represent vulnerability within the selected area is country-specific and is not to be compared with other European regions. Within Austria, it can be seen that western and southern Austria and Vienna tend to be more vulnerable than the other NUTS 2 regions (European Commission et al., 2023).

Figure 6: Vulnerability Index
At national and NUTS 2 levels

a. European Comparison



b. Comparability among national regions



Source: Taken from European Commission, Joint Research Centre, Eklund, G., Salvi, A., Antofie, T. et al., *Towards a European wide vulnerability framework – A flexible approach for vulnerability assessment using composite indicators*, Publications Office of the European Union, 2023,

As mentioned, earlier the EU is striving for convergence between the member states, which is supported by its cohesion policy. However, recent crises such as the 2008 financial crisis, the 2015/2016 refugee movements, the COVID-19 pandemic and the ongoing war in Ukraine have disrupted this process. Convergence means reducing the differences between regions, with less developed economies growing faster than mature ones. This can lead to interregional migration of labour and capital. Despite the EU's efforts to harmonize living conditions, significant regional differences remain, especially at internal borders (Hippe et al., 2024).

The application of the method of convergence between territories is widespread, especially in an economic framework, but the inclusion of demographic factors has not yet been done extensively (Kashnitsky et al., 2017). In their study, Kashnitsky et al. (2017) examine regional differences in population ageing in Europe over the last ten years and predict changes over the next thirty years. The results indicate a convergence of ageing in the period 2003-2012, which is expected to continue from 2013-2022 and 2033-2042 according to Eurostat forecasts. The convergence is mainly due to changes in the Eastern European regions, with cohort turnover and growth in the non-working age population being the most important factors. Working-age mortality rates also have a stable influence. Migration has only a minimal impact in the long term but causes fluctuations in certain periods.

Studies focusing on convergence of migration and regional vulnerability are not currently available but are of great importance as they provide crucial insights into how different regions adapt to demographic change and socioeconomic pressures. Such studies help to identify the factors driving convergence or divergence and enable policy makers to address vulnerabilities and use migration as a tool for regional resilience and growth. By integrating demographic and economic variables, convergence studies provide a comprehensive framework for analysing the impact of migration on regional stability and long-term strategic goals.

3. DATA & METHOD

3.1 DATA

The methodology of this study is structured into four stages:

1. **National Level Analysis:** The first stage examines the Population Turnover Rate (PTR) and Migration Share of Turnover (MST) at the national level, disaggregated by country of birth, to measure the impact of migration on population dynamics at national level.
2. **Regional Level Analysis:** The second stage analyzes PTR and MST at the NUTS3 level, also disaggregated by country of birth.
3. **Development of the Vulnerability Index:** The third stage develops a vulnerability index based on socio-economic and demographic characteristics and links the index to various migration component shares.
4. **Regional Convergence Analysis:** The final stage examines if NUTS3 regions in Austria exhibit significant differences in the vulnerability index related to MST components and identifies convergence patterns over time.

To conduct these analyses, several datasets were utilized, primarily sourced from Statistik Austria and Eurostat. Demographic data was collected from the "Statcube" platform, the statistical database of Statistics Austria. Since Statistic Austria provides annual data broken down by place of residence at the beginning of the year, the corresponding data level was retrieved for each analysis. All datasets were gathered by country of birth, categorized by "Austrian-born" and "Foreign-born". The datasets were collected for the period from 2002 to 2022, as this is the available data for migration flows. Data for this category prior to 2002 is not available on the Statcube platform.

According to Fassmann et al. (2009), the data availability from 2002 can be traced back to the fact, that until 2001, Austrian municipalities managed their own population registers, leading to discrepancies with census data. In response, the Central Registration System (ZMR) was created in 2001 to standardize data collection and was managed by the Ministry of the Interior, which sends data to the Central Statistical Office. Statistics Austria also introduced a uniform system for

population and migration statistics. In general, residents must register any change of residence or when entering or leaving Austria within three days. Before 2002, the police handled registrations, deterring many, especially foreign nationals. The responsibility shift to municipal services in 2002 increased registrations, revealing many previously unregistered residents. The register excludes diplomats, tourists, seasonal workers, and commuters, and asylum seekers have been registered since 2004. Foreign nationals staying less than 90 days are not counted as migrants.

The individual datasets include:

At a national level:

- Population stocks (based on place of residence as of January 1st) (Statistik Austria, 2023m)
- Population stocks according to age and sex (based on place of residence as of January 1st) (Statistik Austria, 2024a)
- Births (categorized by the mother's birthplace and her residence at the beginning of the year) (Statistik Austria, 2023b)
- Deaths (categorized by residence at the beginning of the year) (Statistik Austria, 2023d)
- International migration data (Statistik Austria, 2023h)

At a regional level, NUTS 3:

- Population stocks (based on place of residence as of January 1st) (Statistik Austria, 2023l)
- Births at municipal level (categorized by the mother's birthplace and her residence at the beginning of the year) this data was harmonized for NUTS 3 level (see 3.1.1) (Statistik Austria, 2023a)
- Deaths (categorized by residence at the beginning of the year) (Statistik Austria, 2023c)
- International migration data (Statistik Austria, 2023g)
- Internal migration flows categorized by “place of origin” and “place of destination”(Statistik Austria, 2023f, 2023e)

For internal migration flows, "place of origin" refers to individuals deregistering from a region, indicating they are leaving or emigrating from that region. Conversely, "place of destination" refers to individuals registering in a new region, indicating they are arriving or immigrating to that region.

Since 2002, Statistic Austria has relied on quarterly reports of main residences submitted by the Central Register of Residents (CRR) for population statistics. These reports are integrated with migration statistics, emphasizing individuals who have maintained a registered main residence for a minimum of 90 days (including the cut-off date) (STATcube, 2023).

For a nuanced analysis, the statistical exploration was carried out across different geographical classifications. Initially, the analysis was performed at the national level using data spanning from 2002 to 2022. Subsequently, examination was conducted at the NUTS 3 level (Nomenclature of Territorial Units for Statistics level 3) for the same period.

Analysis at NUTS 3 level holds significance for national and European Union comparisons. The NUTS 3 level offers the most detailed and standardized regional information, established collaboratively by Eurostat and Member States and has been refined over the years. The most recent amendment, the Tercet Regulation (Regulation (EU) 2017/2391) in January 2018, underscores its ongoing relevance. This system categorizes the territories of Member States into three levels, it establishes minimum and maximum population thresholds for each level (NUTS 3 min: 150,000 / max: 800,000). In the case of Austria, the NUTS 3 level consists of 35 units. Each unit represents an aggregation of multiple municipalities, with each municipality assigned to a single NUTS 3 unit (European Union, 2023).

3.1.1 Data harmonization at municipal level for NUTS 3 level

Given that the datasets for the different variables used in the study were not all provided at the NUTS 3 level but rather at the municipal level, an aggregation process from municipalities to the NUTS 3 level was performed.

To ensure that this aggregation was correctly carried out based on the municipal boundaries of the year 2023, a harmonization process was undertaken beforehand. This harmonization process ensured that all data aligned consistently within the datasets.

For the harmonization process, official information on municipal boundary changes taking effect in the period from 2002 until 2023 was collected and these changes were applied when the data

was provided according to municipalities (in German: “Gemeinden”). To ensure accuracy, these changes were documented using the 5-digit municipality code GKZ (“Gemeindekennziffer”). A total of 736 changes were recorded, including changes to GKZ numbers, municipal mergers, splits, and mergers of municipalities into newly formed units. The majority of these adjustments were due to a structural reform in Styria that came into force on January 1, 2015. The primary objectives of this reform were to strengthen the economic and infrastructural capacity of the municipalities in response to regional demographic change (Das Land Steiermark, 2014).

3.1.2 Data selected to develop the vulnerability index

To develop a vulnerability index, which combines several indicators into a single score representing the degree of vulnerability, three dimensions were identified: (1) demographic, (2) social, and (3) economic. Indicators were selected under these dimensions based on the OECD Better Life Index[2] and the assessment conducted by Damoun et al., (2024). For the Austrian NUTS 3 regions, the following seven indicators, as detailed in Table 2, were chosen due to their relevance:

Table 2: Indicators according to dimension and relevance

Dimension	Indicator	Definition & Relevance
Demographic	Population growth rate	Rate at which the population is increasing or decreasing.
	Share (%) of the population aged above 65	Measure of an “aged” society.
	Population Density	Quantifies the quantity of persons in a defined area. A densely populated area indicates improved infrastructure, access to public services etc.
Social	Life expectancy (LE) at birth (reference taken for the male population)	Measure of health: average (number of years) a person can expect to live at birth. LE for the male pop. was chosen due to a greater variance in the data for a better differentiation of the regions
	Tertiary education level achieved (% of people aged 15-64 with a university degree)	Education equips individuals with knowledge, and competencies for effective societal and economic participation.
Economic	Annual GDP per capita	Monetary measure of the size and performance of the economy.
	GDP change rate per capita (between 2011 and 2021)	Rate at which the GDP is changing.
	Unemployment rate (% of people aged 25-64 employed)	Measure of stability and health of the economy.

[2] www.oecdbetterlifeindex.org

Furthermore, the most recent data for the indicators was available for the year 2021, so this year was chosen for the assessment. For comparative purposes, the year 2011 was also selected to provide a decade-long comparison. The following datasets were used for the indicators:

- Annual Gross Domestic Product (GDP) per capita in Euros according to NUTS 3 level in Austria (years 2011 and 2021)(Eurostat, 2023, 2024a)
- Educational Attainment – Share of population aged between 25-64 years with at most a university degree at municipal level (year 2021) this data was harmonized for NUTS 3 level (see 3.1.1) (Statistik Austria, 2021b)
- Unemployment rate share in % at municipal level (year 2021) this data was harmonized for NUTS 3 level (see 3.1.1)(Statistik Austria, 2021a)
- Life expectancy at birth (for males)(Statistik Austria, 2023i)
- Population aged 65 and older (at the beginning of the year 2021) according to NUTS 3 level (Statistik Austria, 2024b)
- Population density by NUTS 3 regions (year 2021) (Eurostat, 2024b)

3.1.3 Software

All the statistical analysis and necessary data preparation in this study were conducted using the R programming language, which was also utilized to generate the graphs presented in this study.

3.2 METHOD

This analysis is inspired by Francesco Billari's (2022) recent research advocating for a deeper understanding and application of “rapid demography”. This approach is particularly relevant for Austria, which has experienced significant migration flows. By 2020, the foreign-born population in Austria exceeded 20% and continues to grow (OECD, 2023). Billari highlights that in low-fertility and low-mortality countries, international migration has become the key driver of population change, challenging the traditional notion that population change is primarily driven by fertility and mortality rates. In his paper Billari explores how migratory movements significantly accelerate population dynamics, utilizing global and country specific data from Italy and Germany. For this purpose, he introduces the metrics Population Turnover Rate (PTR) and the Migration Share of Turnover (MST).

The PTR adds all gross demographic rates (birth, death, immigration and emigration rates) within a population. In contrast to "net population change", which calculates the difference in population size between two points in time, the PTR offers a more nuanced understanding of demographic dynamics. While a population size may appear stable, turnover shows how its composition changes over time. This measure allows to capture changes in the population structure even if the total population size remains relatively constant. The MST further assess the consequences of migratory movements in the overall PTR considering international immigration and emigration, as well as internal immigration and emigration within the geographical unit observed (Billari, 2022).

Building on Billari's research, this study extends the analysis beyond calculating total PTR and MST, as it introduces a new dimension by calculating these measures based on the country of birth, distinguishing between "native-born" and "foreign-born" individuals. This distinction is important because a person's country of birth remains stable over time, unlike citizenship, which can change through naturalization. People migrating can be identified on the basis of their nationality or country of birth, with foreign-born defined as those who have migrated from their country of origin to their current country of residence. For the analysis utilizing country of birth over citizenship avoids undercounting events particularly emigrations, which can occur more frequently, if citizenship is used. Analyzing the data segregated by country of birth allows for a detailed break down and quantification of the foreign-born population´s contribution to the PTR and MST components.

In this study, the PTR and MST are calculated at two levels: nationally and regionally (NUTS 3). The analysis spans from 2002 to 2022, with annual calculations at both levels. Additionally, for the NUTS 3 regions, five-year periods (2005-2009, 2010-2014, and 2015-2019) are created to provide a comprehensive understanding of the development of PTR and MST over time. Boxes 1 and 2 provide the detailed PTR and MST equations used in the study.

Box 1: Equation for Population Turnover Rate (PTR) & Equation for Rates

$$PTR_{j,t,PB} = b_{j,t,PB} + d_{j,t,PB} + in_{j,t,PB} + out_{j,t,PB} + im_{j,t,PB} + em_{j,t,PB}$$

Where:

- ***PTR*** Popupation turnover rate
- ***PB*** Place of birth
- ***j*** specific country / region
- ***t*** specific time period
- ***b*** Birth rate
- ***d*** Death rate
- ***im*** International migration rate
- ***em*** International emigration rate
- ***in*** Internal migration rate
- ***out*** Internal emigration rate

Rates

$$R_{j,t,PB} = \frac{Number\ of\ Events_{j,t,PB}}{PY_{j,t}}$$

- ***R*** Rate
- ***PY*** Persons-years lived

Source: Based on Billari, 2022

Box 2: Equation Migration Share of Turnover (MST)

$$MST_{j,t,PB} = \frac{in_{j,t,PB} + out_{j,t,PB} + im_{j,t,PB} + em_{j,t,PB}}{PTR_{j,t,PB}}$$

Where:

- ***MST*** Migration Share of Turnover
- ***PTR*** Popupation turnover rate
- ***PB*** Place of birth
- ***j*** pecific country / region
- ***t*** specific time period
- ***im*** International migration rate
- ***em*** International emigration rate
- ***out*** Internal migration rate
- ***in*** Internal emigration rate

Source: Based on Billari, 2022

To compute the gross rates the number of events as of residence of the person as of 1st of January (e.g. births in a given year and geographical unit) were divided by the average population of size of the given year which represents the persons-years lived.

3.2.1 Applying the demographic balancing equation

To ensure the quality of the data, the demographic balance equation was applied annually and compared to the following year. This equation, also known as the mass balance equation, calculates the total population at the end of the year. The initial population on January 1st is

adjusted by adding natural growth (births minus deaths), the net international migration and internal movements (immigration minus emigration). This method was applied separately for the population born in Austria and the population born abroad. Box 3 shows the detailed demographic balance equation utilized in this study.

Box 3: Equation Demographic Balancing Equation

$$P_{j,t,PB} = P_{j,(t-1),PB} + b_{j,t,PB} + d_{j,t,PB} + in_{j,t,PB} + out_{j,t,PB} + im_{j,t,PB} + em_{j,t,PB}$$

Where:

- ***P*** Popupation
- ***PB*** Place of bith
- ***j*** specific country / region
- ***t*** specific time period
- ***b*** Birth rate
- ***d*** Death rate
- ***im*** International migration rate
- ***em*** International emigration rate
- ***in*** Internal migration rate
- ***out*** Internal emigration rate

As the data from Statistics Austria are derived from the Central Registration System and recognizing that international emigration is often underreported, it can be assumed that emigrants do not always deregister as there is no incentive to do so. This leads to an inflated statistical migration balance, making discrepancies inevitable (Fassmann et al., 2009). Deviations of 1-2% are considered acceptable and harmless for the analysis, while deviations of more than 2% lead to these years being excluded from the analysis.

3.2.2 Decomposition of the Migration Share of Turnover

The MST indicates the extent to which migration contributes to changes in the PTR. If the MST exceeds 50%, it can be inferred that migration is the primary factor driving population dynamics, indicating a population is reliant on migration. However, the MST alone does not distinguish between changes caused by international emigration or immigration or internal movements. It also does not specify whether these migratory movements are caused by the native or foreign-born population.

Consequently, to allow for a more nuanced analysis, the MST has been decomposed into components representing international and internal movements. This decomposition helps to explain the extent to which different geographic regions depend on migration. Box 4 contains the equations for the decomposed MST.

Box 4: Equations Decomposition of the Migration Share of Turnover (MST)

$$\mathbf{MST}^{int}_{\mathbf{j,t},PB} = \frac{im_{j,t,PB} + em_{j,t,PB}}{PTR_{j,t,PB}} \qquad \mathbf{MST}^{in}_{\mathbf{j,t},PB} = \frac{in_{j,t,PB} + out_{j,t,PB}}{PTR_{j,t,PB}}$$

Where:

- $\mathbf{MST}^{int}$ International Migration Share of Turnover
- $\mathbf{MST}^{in}$ Internal Migration Share of Turnover
- ***PTR*** Popupation turnover rate
- ***PB*** Place of birth
- ***j*** specific country / region
- ***t*** specific time period
- ***im*** International migration rate
- ***em*** International emigration rate
- ***out*** Internal migration rate
- ***in*** Internal emigration rate

Source: Based on Billari, 2022

3.2.3 Composite vulnerability indicator and its relationship with the decomposed MST

After conducting a detailed analysis of PTR and MST over time, it is important to link these measures to the socioeconomic determinants that influence population dynamics in order to better understand the relationship between demographic and socioeconomic characteristics of a region. In line with the objectives of the PREMIUM_EU project to identify vulnerable areas within the European Union, this study focuses on the Austrian case and prepares a composite vulnerability index. A composite index is calculated as the sum of weighted, normalized selected indicators (Mazziotta & Pareto, 2016).

This index is developed following the methodology applied by Damoun et al., (2024) for the Spanish case, based on the scientific publication by Mazziotta & Pareto (2016). The index comprises three dimensions: (1) demographic, (2) social, and (3) economic. For each dimension, relevant indicators are selected (see section 3.1.2), normalized, weighted equally and aggregated to form the index. The calculation is performed so that a high index indicates a low vulnerability

level. Therefore, before aggregating the normalized weighted indicators, indicators not considered positive for low vulnerability, such as the unemployment rate and the share of the population aged 65 and older, are adjusted to be considered negative. Box 5 provides a mathematical description of the applied method.

Box 5: Equations Composite Vulnerability Index & Normalization

$$\textbf{Vulnerabily Index} = \sum_{i=1}^{n} w_i \cdot N \qquad N_i = \frac{I_i - min(I_i)}{max\ (I_i) - min(I_i)}$$

Where:

- ***Index*** Aggregated index
- ***i*** i-th indicator (e.g GDP per capita)
- ***I*** Indicator
- ***w*** Assigned weith to the indicator
- ***n*** Total number of indicators
- ***N*** Normalization of each indicator

Dimensions and Indicators of Vulnerability:

Demographic:	Population grwoth
	Share of +65 population
	Population density
Social :	Life expectancy at birth
	Tertiary Education level achieved
Economic:	GDP per capita
	Change in GDP per capita
	Unemployment rate

Source: Based on Damoun et al., 2024

After calculating the vulnerability index for each NUTS 3 region, the regions are divided into four vulnerability levels based on statistical quartiles: "low", "medium-low", "medium-high" and "high". These regions are then grouped according to the vulnerability levels and analyzed as per the breakdown of the MST – which include the share of international immigration and emigration and share of internal immigration and emigration - differentiated by country of birth. These detailed breakdown and differentiation enable a thorough assessment of the development of the individual MST components over the total PTR in the period from 2002-2022.

In this context, it is relevant to mention that social vulnerability is considered a "latent" variable, i.e. it is inherent to a person, population or place but cannot be observed directly. Quantitatively, social vulnerability can only be measured indirectly through statistical methods. By collecting sufficient data on measurable factors, such as the demographic characteristics of an area, a numerical value representing social vulnerability can be defined. In contrast to directly observable factors such as education level, income or rent, social vulnerability must be estimated indirectly

using statistical methods. These methods, which are often used in the creation of composite indices, offer a way of quantifying social vulnerability. However, it should be noted that although social vulnerability indices are widely used, they have not yet been definitively validated (Spielman et al., 2020).

3.2.4 Regional convergence analysis of the MST in the NUTS 3 regions

In the final stage of the study, after examining how the PTR and MST vary across NUTS 3 regions, as well as their vulnerability levels and their relationship to the MST components, it is important to assess whether the regions in Austria are converging towards the same migratory pattern or diverging. To achieve this, a beta β-convergence analysis was chosen.

Overall, the beta convergence is appropriate in this context because it helps analyze whether regions with initially different levels of MST are becoming more similar over time. This analysis can reveal if vulnerable regions are catching up with less vulnerable ones, indicating a reduction in regional disparities, or if regions are diverging, highlighting increasing inequalities. By applying β-convergence, the speed and direction of convergence or divergence can be quantified.

Furthermore, in this case a conditional β-convergence was applied, this specifically means that the change in MST on the initial value has been regressed by using vulnerability as a condition. For this purpose, the linear regression model applied by Damoun et al., (2024), based on the methodology of Kashnitsky et al., (2017) and Wieland, (2019) was followed as described in Box 6.

Box 6: Equation Conditional Beta Convergence & Interpretation of Beta

$$\frac{1}{T}\sum_{t=1}^{T} ln\frac{MST_{t-1}}{MST_{t}} = \alpha + \beta\, MST_{0j,} + \gamma V_{j} + \varepsilon$$

Where:

- MST Migration Share of Turnover
- MST_{1j} MST for j at the end of the observed period
- MST_{0j} MST for j at the beginning of the observed period.
- j specific country / region
- α Intercept
- β Coefficient indicates the rate of convergence or divergence
- γ Coefficient that measures the impact of V
- V Vulnerability Index (condition variable)
- ε Error term

Interpretation of β:

- ***Convergence*** ***(β <0)*** When β is negative and statistically significant
- ***Divergence*** ***(β > 0)*** When β is positive and statistically significant
- ***No Convergence*** ***(β= 0)*** When β is not significantly different from zero, no systematic convergence

Source: Based on Kashnitsky et al., (2017) and Wieland, (2019)

The dependent variable in this equation is the average growth rate of MST over the period T, represented by the left side of the equation. To verify that convergence took place over the observed period, the growth rate of MST on the left side of the equation should be negatively correlated with the initial MST value, indicated by a negative beta coefficient. If beta is negative and statistically significant, it implies convergence, meaning regions with initially higher MST are growing slower than those with initially lower MST, reducing regional disparities.

The coefficient gamma measures how much the vulnerability of a region (as captured by the Vulnerability Index) influences its MST growth rate. A positive gamma would indicate that higher vulnerability is associated with higher MST growth, while a negative gamma would suggest that higher vulnerability is associated with lower MST growth.

4. RESULTS

4.1 DESRCRIPTIVE RESULTS

4.1.1 PTR and MST at national level

Figure 7 shows the Population Turnover Rate (PTR) and the Migration Share of Turnover (MST) in Austria from 2002 to 2022, differentiated by place of birth in Austrian-born and foreign-born, together with the total values for each category and their means. The total PTR resembles gradual mild increase over time 2002 to 2014, showing a slight upward trend from 2015 onwards, with a notable increase around 2022. The total MST shows a gradual increase over the years, with a significant rise in the later years, particularly noticeable in the years above the average MST and clearly in 2022. The average total PTR in the time observed is 46‰ and the average total MST is 58%.

The total PTR ranges from 24 in 2002 to 63‰ persons, with the highest value in 2022, the year with the most recent data at the time of this study. Two lows can be observed in 2002 and 2020 and a peak in 2015; this pattern can also be observed in the PTR for the foreign-born group, indicating a clear influence on the overall PTR. In contrast, the PTR for the Austrian-born group is rather stable over time and ranges between 21 and 18 ‰ persons.

The total MST and the MST for the foreign-born follow the same pattern as the overall PTR, with the difference that the total MST fluctuates between 53 and 68% and the MST for the foreign-born between 40 and 62%. The MST for the Austrian-born is stable over time, decreasing from 14% to 7%, with the lowest value reached in 2022.

Figure 7: Population Turnover Rate (PTR) & Migration Share of Turnover (MST), Austria for the period 2002-2022

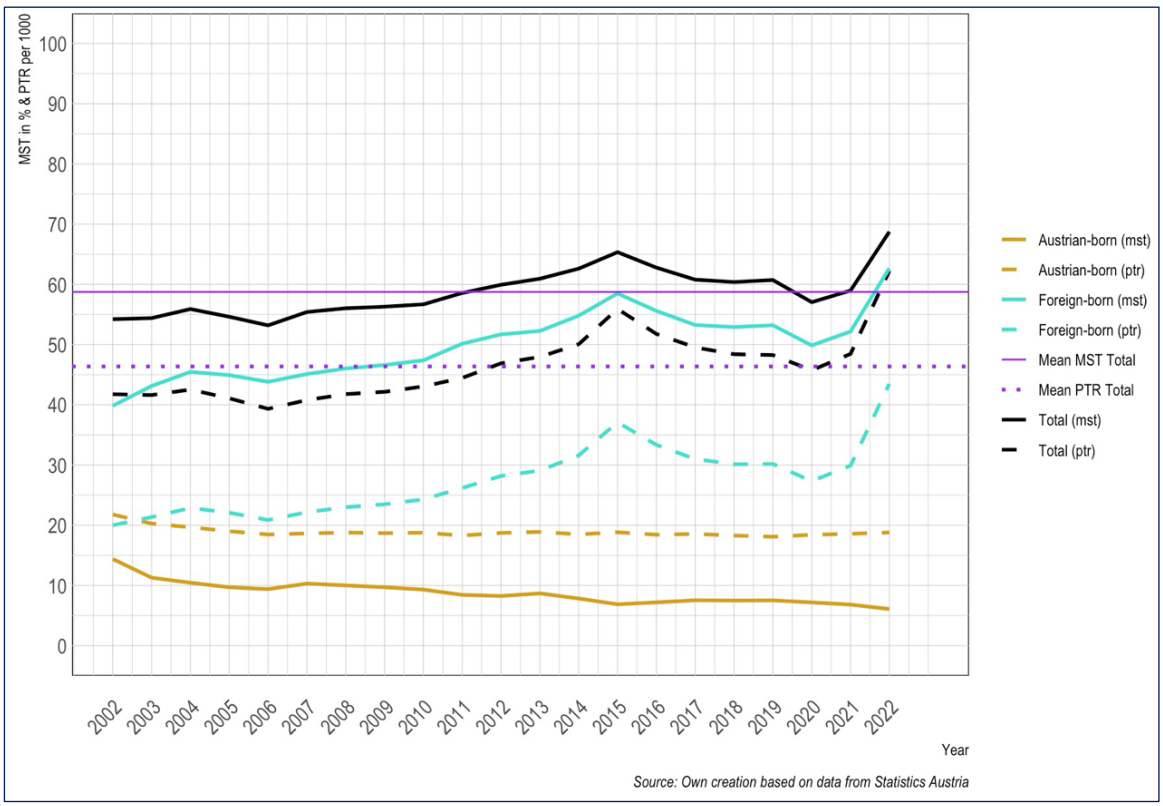
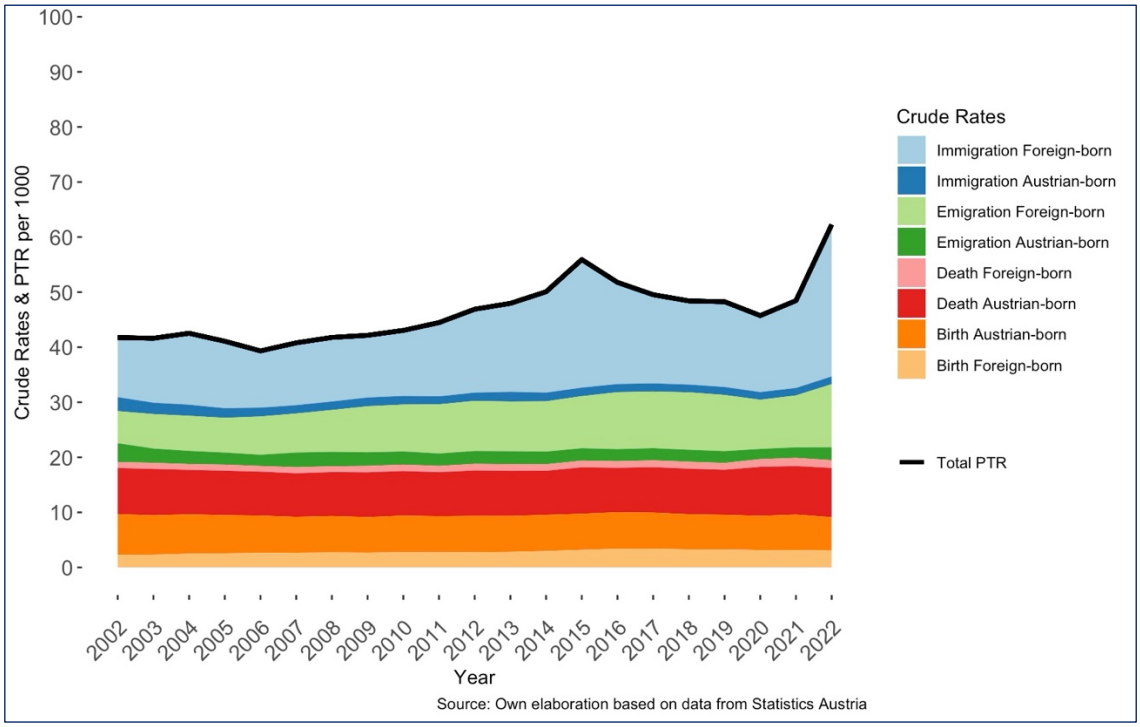


Figure 8 shows the decomposition of the total PTR into respective crude rates over time, clearly showing which demographic processes drive the PTR and those that play a minor role. International immigration and emigration of persons born in Austria remain stable over time and each account for less than 5% of the PTR. The death rate of persons born abroad is also very low (ca. 2 ‰ persons). The birth rate of persons born abroad is relatively low and remains constant at 5 ‰ persons.

The primary factors influencing the Population Turnover Rate (PTR) are the birth and death rates of individuals born in Austria and the emigration and immigration rates of individuals born abroad. The birth and death rates remain stable over time at approximately 10‰, as does the emigration rate of foreign-born individuals. The most significant driver is the immigration rate of those born abroad, which exhibits considerable fluctuation, peaking at 28‰ in 2022. Therefore, the data shows that the overall volatility in the PTR is mainly due to the foreign-born population, as the observed maxima and minima are attributable to changes in international migration flows of the foreign-born population.

Figure 8: Annual Population Turnover Rate (PTR) & Crude Rates Austria for the period 2002-2022

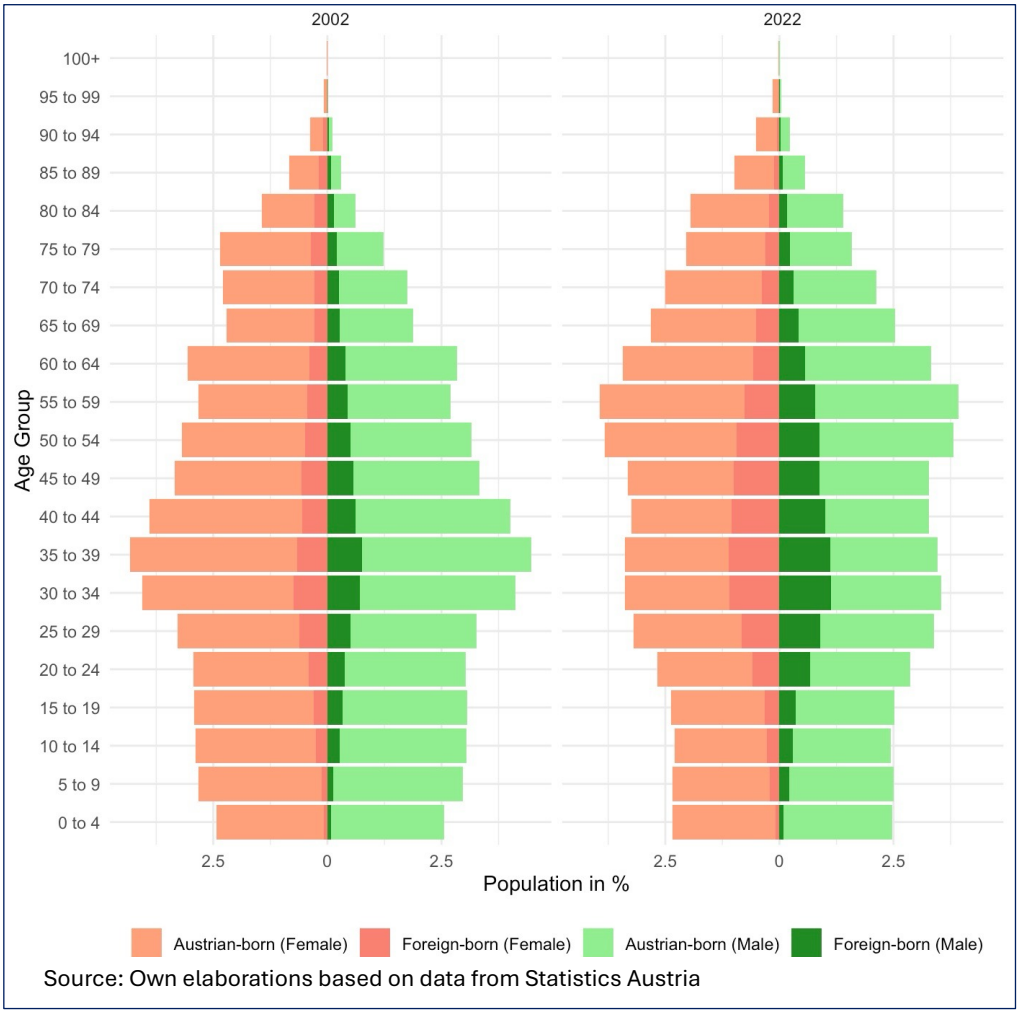


These demographic dynamics are further illustrated by Austria's evolving population structure, as shown in the population pyramids for 2002 and 2022 (Figure 9). The pyramids reveal a significant shift towards an aging population, characterized by a growing proportion of older adults and a narrowing base, indicating fewer children. In 2022, the foreign-born population increased substantially, particularly among the working-age and older cohorts. While in 2002, foreign-born individuals were mainly found in the middle working-age group (25-49 years), by 2022, this demographic expanded to include younger working-age individuals (20-39 years) and those approaching retirement (55-64 years). In contrast, the proportion of Austrian-born individuals declined across most age groups, especially among younger populations (0-19 years), reflecting lower birth rates. However, a slight increase in Austrian-born individuals is observed in age groups above 50, consistent with the aging trend of the native population. Both pyramids also highlight typical gender differences, with a higher number of women than men in older age groups, which reflects higher life expectancy among females. This gender pattern has remained stable over the past two decades.

Overall, these population pyramids indicate that Austria is experiencing demographic aging, with immigration playing a crucial role in maintaining its working-age population. The increasing presence of foreign-born individuals in older age cohorts suggests that migration has been key in

mitigating some effects of the aging native population. As such, migration is not only essential to the Population Turnover Rate (PTR) but also vital for sustaining the demographic balance required for Austria's economic and social well-being.

Figure 9: Populations Pyramids of Austria by country of birth for the years 2002 & 2022



4.1.2 PTR and MST at NUTS 3 level

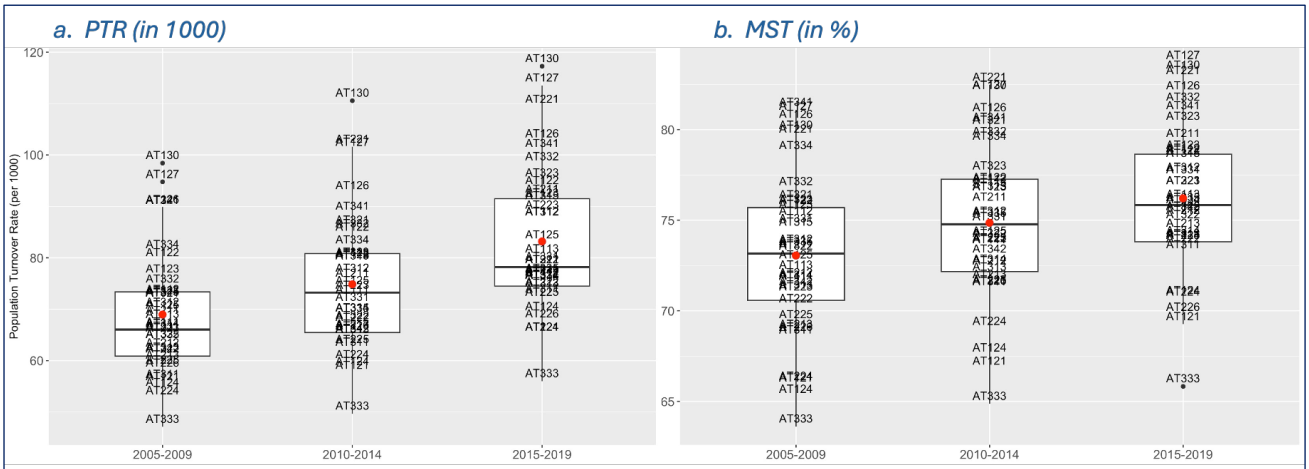
The boxplots in Figure 10 display the Population Turnover Rate (PTR) in graph a and the Migration Share of Turnover (MST) in graph b for Austria's NUTS 3 regions (refer to Appendix 8.5 for codes and region names) across three five-year periods: 2005-2009, 2010-2014, and 2015-2019. Notably, unlike national-level calculations, these regional analyses include internal movements (immigration and emigration). As a result, the PTR and MST values for the regions are anticipated to be higher than those at the national level.

In graph a, the PTR shows a clear upward trend over the three periods. From 2005-2009, the median PTR is 66‰ with values ranging from 47 to 98‰, including some outliers. The period 2010-2014 sees a similar distribution, with a median close to 73‰ and more pronounced outliers. The period 2015-2019 shows a noticeable increase, with the median PTR reaching around 78‰ and values ranging up to 117‰, indicating an increasing population turnover rate in Austria's NUTS 3 regions.

Graph b reveals that the overall MST, which now includes both internal and international migration rates, also exhibits an upward trend across the same periods. From 2005-2009, the median MST is around 73%, with values ranging from 63% to 81% and several outliers. The distribution remains similar in 2010-2014, with a median close to 74%. By 2015-2019, the median MST rises to around 75%, with the third quartile reaching 78%, reflecting a growing share of migration in the population turnover.

Overall, the boxplots highlight an increasing trend in both PTR and MST over the observed periods. The rising median values and the consistent presence of outliers indicate dynamic changes in population turnover and the significant role of migration in shaping demographic patterns across Austria's NUTS 3 regions. Specific regions like AT130 (Vienna), AT127 (Vienna Surrounding Area South) and AT221 (Graz) frequently exhibiting the highest values for both the PTR and MST, while the lowest values were shown by the regions AT333 (East Tyrol), AT224 (Tyrolean Oberland) and AT121(Mostviertel- Eisenwurzen).

Figure 10: Boxplots for PTR and MST
According to NUTS 3 Regions in five-year periods, Austria



Five-year periods between 2005-2019. In the box-plots, each NUTS 3 region is represented, the box shows the first quartile, median and third quartile. The red dot is the mean.

Source: Own elaborations based on data from Statistics Austria

4.1.3 Disagregation of MST components: A NUTS 1 & 3 level comparison

The graphs in figures 11 and 12 each show a panel divided into three parts representing the NUTS 1 regions of Austria: Eastern Austria (AT 1), Southern Austria (AT 2) and Western Austria (AT 3) with lines for each NUTS 3 region within the NUTS 1 regions. The panels are divided according to NUTS 1 for better organization and visualization of the data. The NUTS 1 region AT 1 includes the federal states Burgenland, Lower Austria and Vienna, AT 2 includes Carinthia and Styria and AT 3 Upper Austria, Salzburg, Tyrol and Voralberg. Both figures 11 and 12 show a different decomposition of the MST over the period from 2002 to 2022 by Austrian and foreign-born.

Figure 11 shows the international MST, which is composed by the sum of the international immigration and emigration shares over the total PTR. Overall, the international MST of those born in Austria remains below 10% in all regions with a uniformly decreasing tendency, except for AT342 (Rheintal Bodenseegebiet) in Western Austria (graph c), where the international MST was slightly above 10% until 2014.

In contrast, the international MST of the foreign-born fluctuates and varies over time in all regions. On the one hand, eastern and southern Austria (graph a and b) show similar patterns for the international MST of the foreign-born, in most regions the MST fluctuates between 8-30% over time with clear peaks in 2015 and 2022, with two exceptions: in eastern Austria, the AT130 region (Vienna) with an MST of over 35%, which rises over time and reaches its highest value of 48% in

2022, and in southern Austria, the AT221 region (Graz) with a starting point in 2002 of 21%, which rises rapidly over time and reaches its highest value of 37% in 2022.

On the other hand, Western Austria (graph c) shows mixed results for the foreign-born international MST. Most regions show an increase in MST over time with several peaks at varying levels. The starting levels range from 6% to 41%, and twelve out of fifteen regions record the highest international MST in 2022, with levels between 18% and 46%. The region AT334 (Tiroler Oberland) stands out with the highest starting value across all regions in the three graphs at 41%. Its MST fluctuates over time but overall decreases.

Figure 11: International MST

According to NUTS 1 & 3 Regions in Austria over time

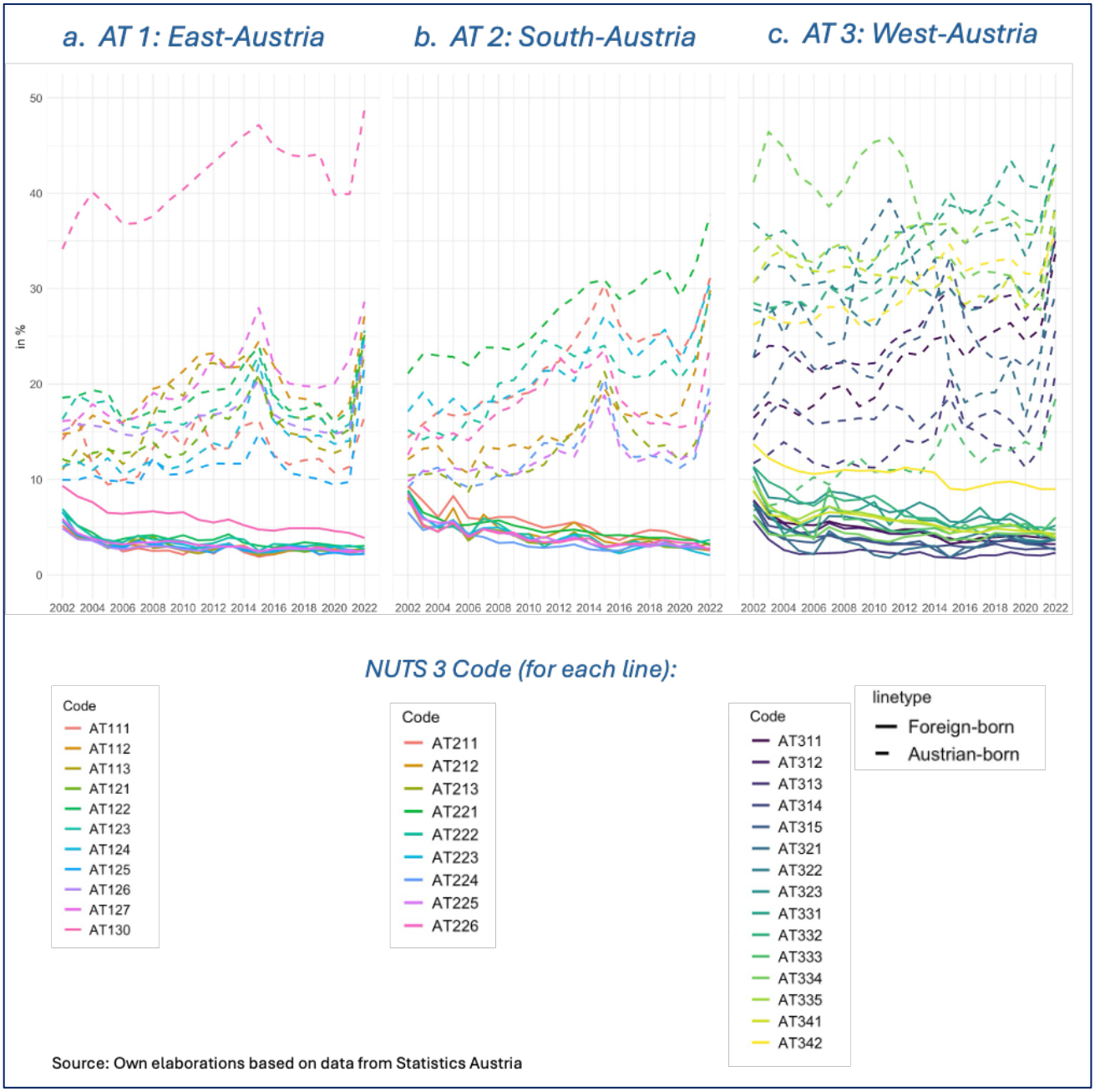


Figure 12 shows the internal MST, which is composed by the sum of the internal immigration and emigration shares over the total PTR. Here for all the three NUTS 1 regions a converse pattern in comparison to the international MST can be observed then in this case the Austrian-born group shows higher levels of MST than the foreign-born.

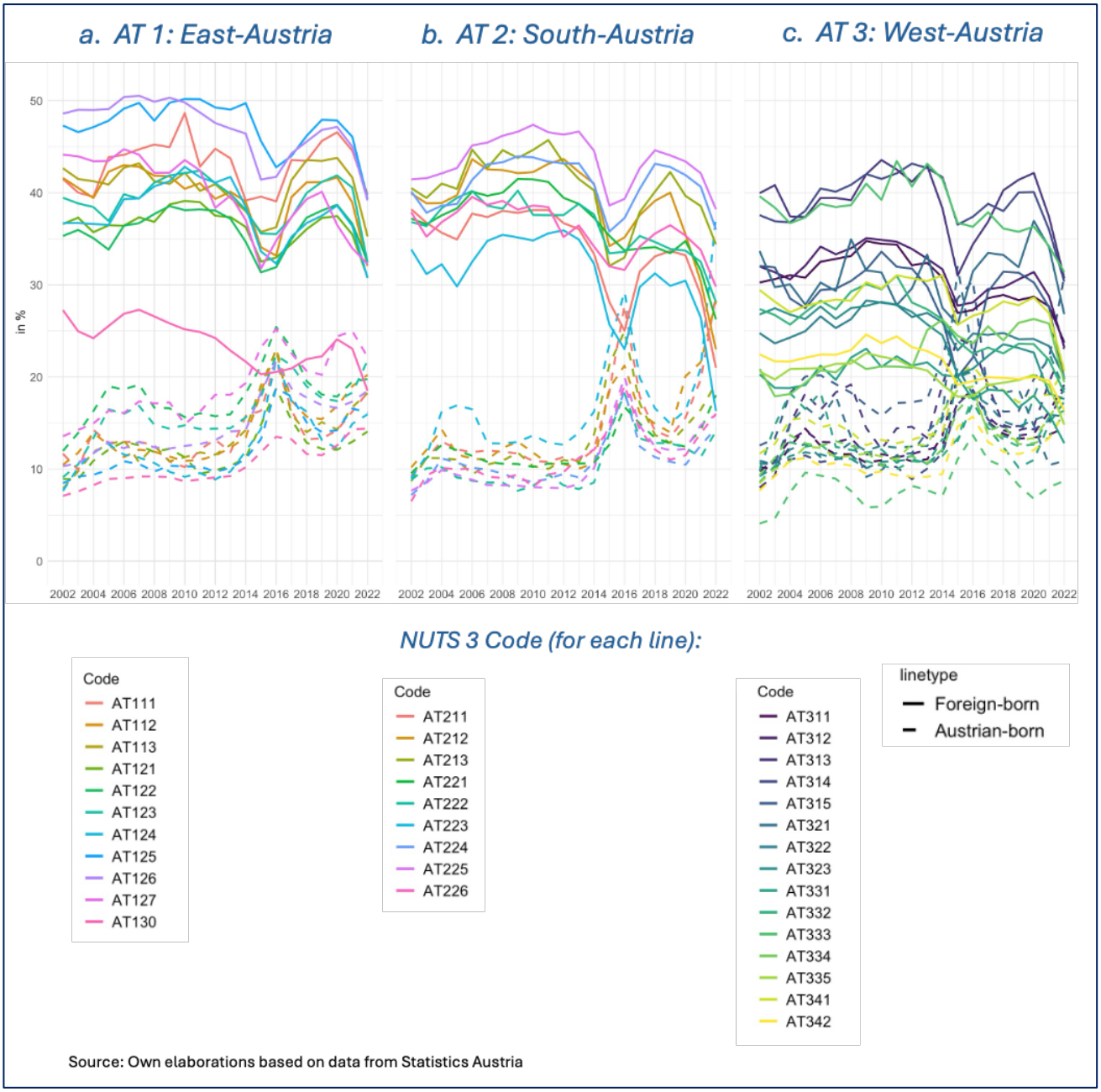
Under graph a, the internal MST for the Austrian-born group remains above 30% over time for all regions with one exception, ranging from 30% to 50%. The curves show a fluctuating increase until

2014, followed by a sharp decrease in 2015. In 2020, another peak is observed, and finally, in 2022, another sharp decrease occurs, reaching the lowest point for all regions. The only exception that does not follow the described behavior is AT130 (Vienna), which has an MST ranging from 27% to 18% in 2022. The foreign-born group generally exhibits lower levels of internal MST over time, ranging from 7% to 25%. Instead of the sharp decreases seen in the Austrian-born group, the foreign-born group shows a distinct peak in 2016.

Graph b shows a similar behavior to graph for both groups, with the difference that the levels of internal MST are overall lower. For instance, the MST for Austrian-born remain below 47% over time, while for the foreign-born group, the MST reaches values above 25%. Notably, the region AT226 (Westliche Obersteiermark) exceptionally reaches the highest MST level for the foreign-born group in 2022, with 37%.

Graph c shows again mixed results with less clear patterns to observe in comparison to the previous graphs. Here the gap in internal MST between the foreign and Austrian born groups is less evident as in the other graphs. All internal MST levels remain below 45%. For the Austrian-born group also sharp decreases are observed in 2015 and in 2022, as observed in the other two graphs.

Figure 12: Internal MST
According to NUTS 1 & 3 Regions in Austria over time



Source: Own elaborations based on data from Statistics Austria

The descriptive results show that the total PTR at national level exhibits a "fast" demography, characterized by several peaks, with the main contribution coming from the international immigration of the foreign-born group. The average total MST over the observed period 58%, indicates that international migratory movements from both groups Austrian and foreign-born are the main driver of population dynamics in Austria. In contrast, the rate of Austrian-born PTR is rather slow and steady, evidencing a “slow” demography.

The data also reflect significant changes in PTR and MST in the years 2015 and 2022, as well as noticeable changes for the years 2004 and 2007, suggesting that historical events linked to changes in migration policies played a relevant role.

This began with the great enlargement in 2004, which saw the entrance of ten new member states (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia) into the European Union. The integration of Bulgaria and Romania into the EU in 2007 and the accession of Croatia in 2013 also significantly impacted immigration rates. Furthermore, the wars in 2015 in Syria and 2022 in Ukraine also affected the movement of people immigrating to Europe and for the Austrian case these events show a clear effect on the MST and consequently on the PTR.

Following the initial descriptive results, it is evident that migratory movements are essential in the PTR. Therefore, decomposing the MST at the regional level to understand how regions behave was necessary. The descriptive analysis at a regional level highlights the importance of examining the individual development of regions within Austria, as there are significant differences in how Austrian-born and foreign-born individuals migrate between regions and how international migration affects regions differently. Additionally, the internal movements of the Austrian-born population and increasing movements of the foreign-born group play a crucial role in shaping regional dynamics, further emphasizing the need for a detailed regional analysis.

4.2 PTR AND MST IN REGIONS BY THEIR SOCIO-ECONOMIC VULNERABILITY LEVELS

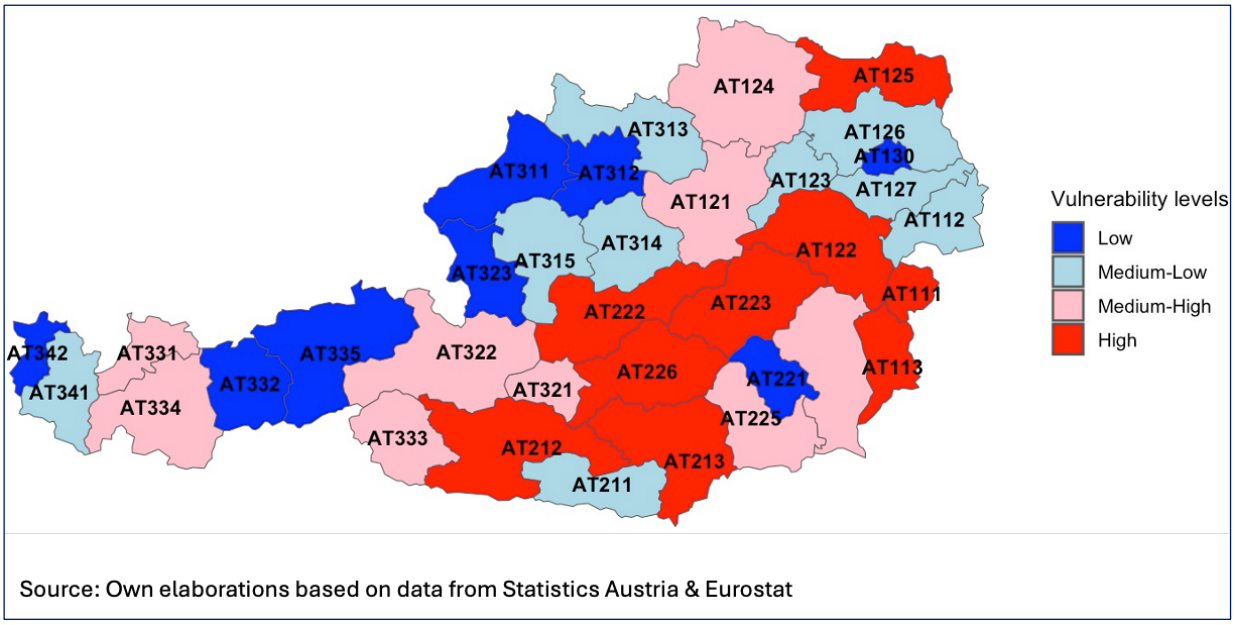
For a more comprehensive analysis of the NUTS 3 regional development in the context of population dynamics and migratory movements in Austria, the vulnerability index was calculated in statistical quartiles as described in chapter 3 and applied to the NUTS 3 regions. Figure 13 illustrates, in a map of Austria, how the vulnerability levels fall into four categories: low vulnerability, medium-low vulnerability, medium-high vulnerability, and high vulnerability.

The map shows that there is no absolutely clear geographical pattern in the distribution of the regions according to their vulnerability levels, but a tendency can be identified in degree of vulnerability and degree of urbanization. Considering that most of the NUTS 3 regions in Austria are

classified as predominantly rural (Statistik Austria, 2023k)- 24 out of 35, or around 68%- it is relevant to consider this linkage in the results.

Regions with high vulnerability are located mostly in the center and south of Austria, except for AT125 (Weinviertel) located in the northeast. These regions are also mostly predominantly rural, except for Niederösterreich-Süd (AT122) and Östliche Obersteiermark (AT223), which are intermediate regions. Regions with low vulnerability tend to be predominantly urban areas like Vienna (AT130), Rheintal-Bodenseegebiet (AT342), Innsbruck (AT332), or intermediate areas like Graz (AT221), Salzburg and Sorrounding (AT323) and Linz-Wels (AT312) except for Innviertel (AT311) which is predominantly rural. Regions with medium-high vulnerability and medium-low vulnerability are generally predominantly rural, apart from Vienna Surrounding North (AT126) and Vienna Surrounding South (AT127), which are predominantly urban, and Klagenfurt-Villach (AT211), which is intermediate.

Figure 13: Vulnerability by NUTS 3 Regions in Austria

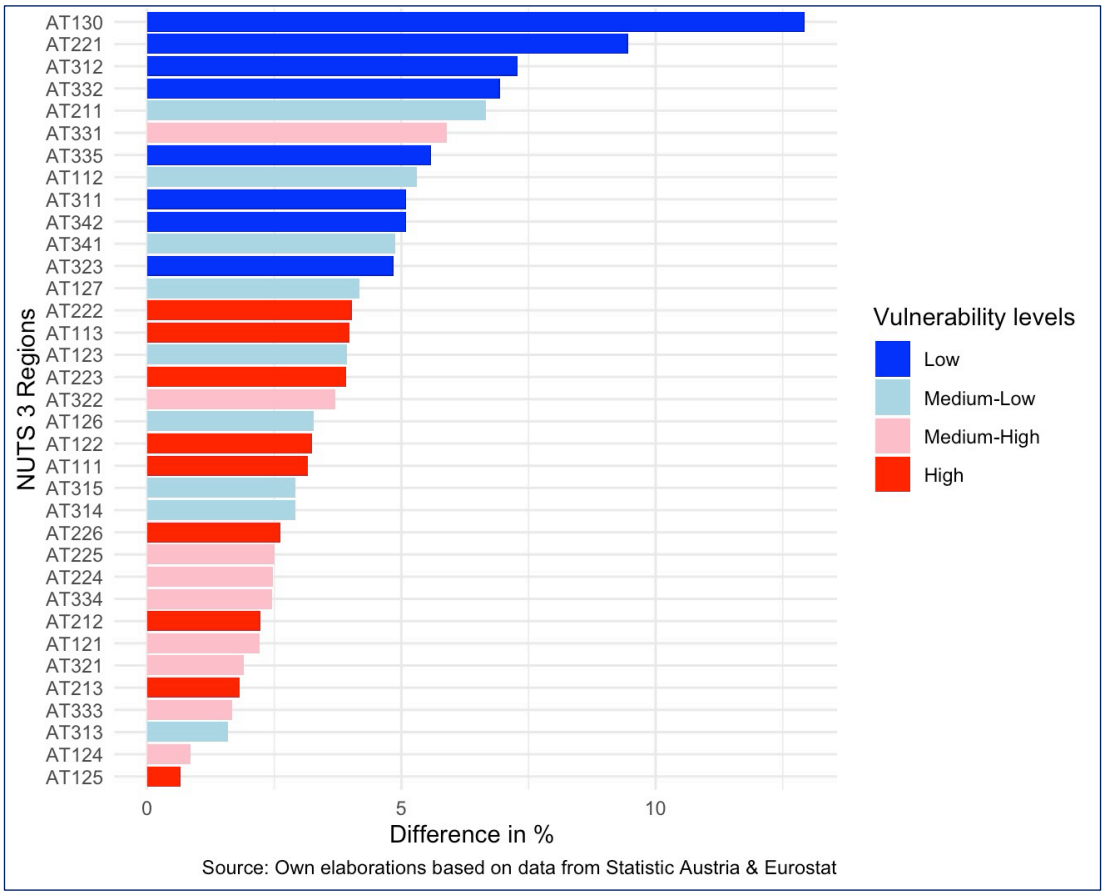


Source: Own elaborations based on data from Statistics Austria & Eurostat

Figure 14 illustrates the percentages of the foreign-born population in each NUTS 3 region according to vulnerability levels for the years 2002 and 2022, marking the beginning and end of the observation period. The data shows that all regions experienced an increase in the foreign-born population, with increases ranging between 0.6% and 12.9%, and an average increase of 4%.

The regions with the largest increases in the foreign-born population are AT130 (Vienna) with 12.9%, AT221 (Graz) with 9.4%, and AT312 (Linz-Wels) with 7.2%, all of which are low-vulnerability regions. The regions with the smallest increases are AT125 (Weinviertel) with 0.6% and high vulnerability, AT124 (Waldviertel) and medium-high vulnerability and AT313 (Mühlviertel) with 1.5% with medium-low vulnerabiliy. A geographical pattern can be observed, as all the regions with the smallest increases are located in the north of the country and tend to be medium-high and high vulnerable regions, except for AT313 which is medium-low vulnerable.

Figure 14: Difference in Foreign-born Population (%) in NUTS 3 Regions, Austria between 2022 & 2002



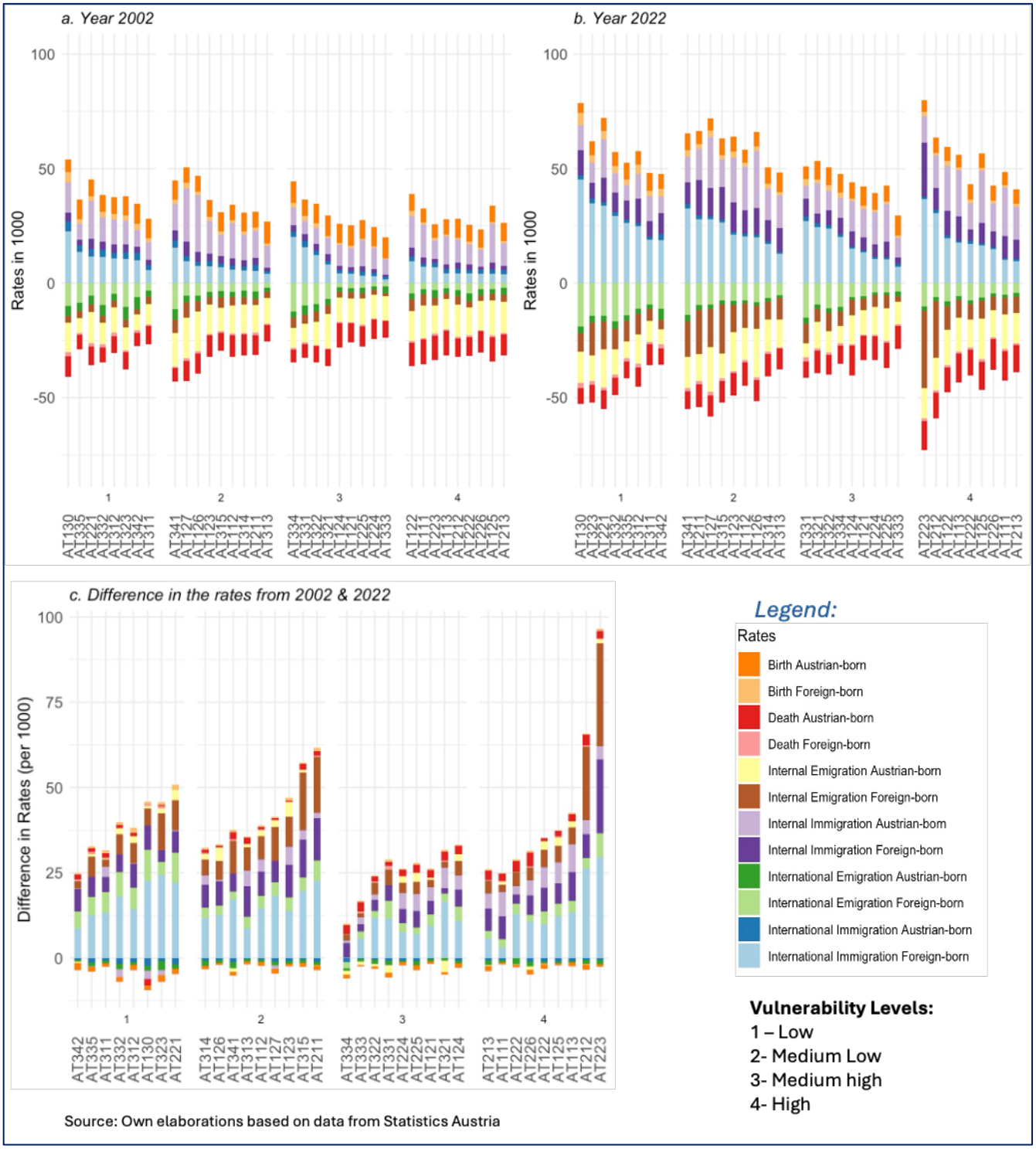
Furthermore, when comparing the composition of the crude rates in the PTR in the different NUTS 3 regions for the first and last year of the period observed (2002 and 2022) according to vulnerability levels, as shown in Figure 15, it becomes evident that in 2002 (Graph a.), the regions with the highest vulnerability level (level 4) exhibit the lowest levels of international immigration rate for the foreign-born group. By the year 2022 (Graph b.), all the NUTS 3 areas demonstrate significant changes, particularly for the foreign-born group. The main differences, as depicted in Graph c, include an increase in the international immigration rates for the foreign-born group and their

internal emigration rates. Notably, across all regions, the birth rates of the Austrian-born population are slightly decreasing, while the death rates are slightly increasing.

Overall, the smallest differences in the rates between the periods observed are shown in the NUTS 3 regions with medium-high vulnerability (level 3). The regions with high vulnerability (level 4) exhibit relatively low changes, except for AT212 (Oberkärnten) and AT223 (Östliche Obersteiermark), which demonstrate outstanding differences among all NUTS 3 regions. The differences for AT223 are primarily observed in the international and internal immigration rates of foreign-born individuals, as well as their internal emigration rates. Regions with low (level 1) and medium-low vulnerability (level 2) generally exhibit greater differences than those in the other groups, particularly in the international immigration rates of the foreign-born population.

Figure 15 clearly demonstrates the significant impact that crude migratory rates have on the PTR over time. This strengthens the argument for implementing the MST measure to achieve a better understanding of population dynamics at the national level and, more importantly, at the regional level, as these dynamics vary from region to region.

Figure 15:Crude Rates for Austrian NUTS 3 Regions
According to Country of Birth & Vulnerability level



Source: Own elaborations based on data from Statistics Austria

4.2.1 Analysis of the MST and its components by vulnerability

Figure 16 provides a detailed breakdown of the components of the Migration Share of Turnover, showing the percentage evolution of each component's weight over the total PTR from 2002 to

2022. The NUTS 3 level data is grouped into four levels of vulnerability as previously defined: low vulnerability (blue), medium-low vulnerability (light blue), medium-high vulnerability (pink), and high vulnerability (red).

The first graphs (a and b) illustrate the international and internal MST according to place of birth: Austrian-born (graph a) and foreign-born (graph b). In graph a, the internal MST for Austrian-born individuals is higher than the international MST, remaining above 20% for all vulnerability levels. Low vulnerability areas (blue line) show the lowest share of internal MST and a decreasing tendency, indicating that these areas experience fewer internal movements. Conversely, high vulnerability areas (red line) exhibit high internal movements, suggesting that regions with higher vulnerability levels are more affected by internal migration. The international MST remains for all the vulnerability levels in this group below 10% and a slowly decreasing tendency.

Graph b displays the MST for foreign-born individuals. Unlike the pattern observed for Austrian-born individuals, the international MST is more pronounced for the foreign-born population. Low vulnerability regions exhibit the highest international MST, with an increasing tendency from 2010 onwards, peaking above 35% in 2015 and 2022. Medium-high and medium-low vulnerability areas show similar trends over time, fluctuating between 15-25%, and both lines nearly reach 30% in 2022. The high vulnerability line follows a similar trajectory to the medium-high and medium-low lines, remaining under 20% until 2022 when it approaches 25%.

The internal MST for foreign-born individuals shows a clearer trend across all vulnerability levels, ranging between 10 and 15% until 2015, followed by a sharp peak around 2016, reaching almost 25%, and then decreasing. Medium-low vulnerability regions and high vulnerability regions (red line) display the highest internal movement. Overall, the pattern indicates that foreign-born individuals are more impacted by international migration than internal movement.

When focusing on the decomposition of international movement (immigration and emigration) as shown in graphs c (for Austrian-born) and d (for foreign-born), different patterns for the two groups can be observed. For the Austrian-born group (graph c), both immigration and emigration movements display the same pattern across all vulnerability levels over time, with levels remaining below 10% and showing a slightly decreasing tendency.

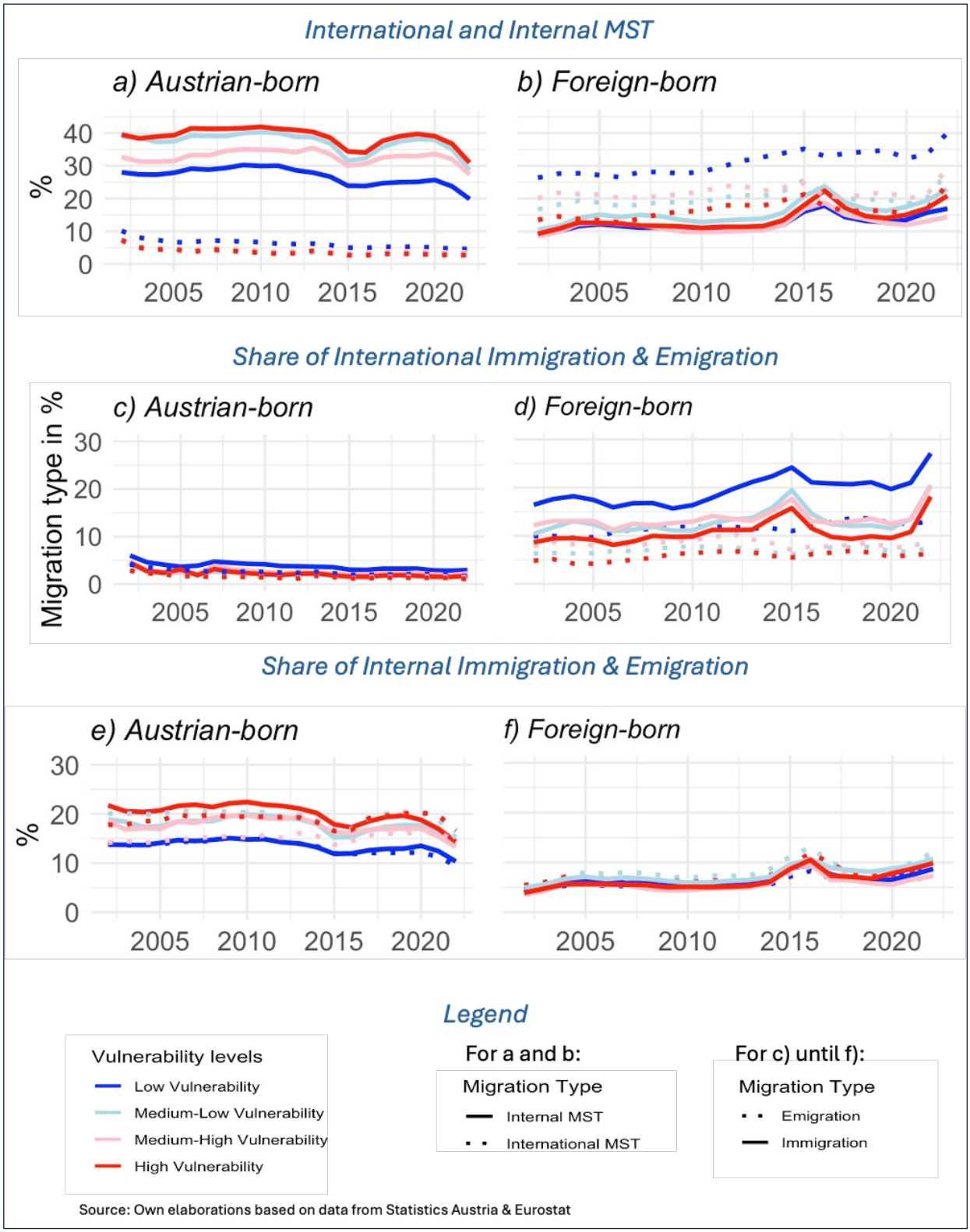
In contrast, for the foreign-born group (graph d), the patterns are more varied. Immigration rates for low vulnerability regions show a clear upward trend, with significant increases peaking around 25% in 2015 and 28% in 2022. Medium-high and medium-low vulnerability regions also demonstrate increasing trends, with immigration rates reaching around 20% in 2015 and 2022. High vulnerability regions exhibit a similar trend but at a lower level, with immigration rates increasing to approximately 18% by 2022. Emigration rates for the foreign-born group follow a less clear pattern but show a stable path over time. Low vulnerability regions experience the highest emigration rates over time between 10 and 14%, followed by medium-high and medium-low vulnerability regions with levels around 10% over time. High vulnerability regions show the lowest emigration rates around the line of 10% with a slightly increasing trend.

For the Austrian-born group (graph e), both internal immigration and emigration movements exhibit similar trends across all vulnerability levels over time. Internal immigration rates remain relatively stable between 8% and 22% until 2015, after which a decrease is visible, followed by a slight upward trend approaching 2020, and then decreasing again below 15%. Regions with low vulnerability display the lowest internal immigration and emigration rates, indicating less internal mobility. Conversely, high vulnerability regions show higher internal immigration and emigration rates, suggesting greater internal movement within these areas.

In graph f, the foreign-born group also displays stable internal immigration and emigration rates with very similar patterns across all vulnerability levels and a clear peak in 2016. Both rates, for all vulnerability levels, range over time between 5% and 10%, peaking around 12% in 2016 and 2022.

Overall, a comparison of the six graphs reveals distinct trends for the Austrian-born and foreign-born groups. The Austrian-born group is predominantly impacted by internal movements, particularly in high-vulnerability areas. In contrast, the foreign-born group is more affected by international immigration, especially in low and medium-low vulnerability regions.

Figure 16: Migration Share of Turnover (MST) and its components by vulnerability levels and place of birth, Austria



Source: Own elaborations based on data from Statistics Austria & Eurostat

4.3 BETA CONVERGENCE ANALYSIS OF NUTS 3 REGIONS

Figure 17 illustrates the results of the beta-convergence regression analysis for Austria's NUTS 3 regions, considering the regions' vulnerability levels. Graph (a) shows estimates for total mobility, including all international and national movements. Graph (b) focuses on outflows (both international and national emigration), while Graph (c) displays inflows (national and international immigration), with the three graphs aggregating movements for Austrian and foreign-born groups. Graph (d) differentiates by country of birth, showing international migration (both immigration and emigration) for the foreign-born group, while Graph (e) depicts internal migration for the Austrian-born group. These analyses (d and e) were implemented to further analyze the convergence of regions by country of birth, as previous analyses indicated that international migration for the foreign-born and internal migration for the Austrian-born showed the highest values in the PTR and MST analysis of the NUTS 3 regions over time. All five graphs illustrate the convergence process from 2002 to 2022.

In the graphs, each data point represents a NUTS 3 region, with different colors and shapes indicating varying levels of vulnerability (low, medium-low, medium-high, and high). The x-axis shows the initial values for the year 2002 in percentage, and the y-axis shows the beta-convergence growth, referring to the relative growth rate of the observed migratory movement for each region, indicating the extent of change over time in reference to the initial value in 2002. Values close to 1 indicate little or no growth, while values above 1 indicate growth. The grey shaded areas around the regression lines represent the confidence intervals.

For all five scenarios analyzed, a negative slope ($\beta < 0$) is observed, indicating a beta-convergence effect among the regions. The strength of this beta-convergence varies across the graphs. Visually, Graphs (c), (d), and (e) display stronger convergence, as the data points fall closer to the regression line, while Graphs (a) and (b) show more scattered points, suggesting moderate convergence. This observation is supported by the coefficient tables for each model (see Appendix 8.5 for more details), which provide the estimates and their corresponding p-values for the beta coefficients. In all cases, the estimates are negative, and the p-values indicate statistical significance (values below 0.05).

Furthermore, the R-squared results for each graph indicate good model fits and statistical significance. Graph (d) (international migration for the foreign-born) and Graph (e) (internal migration for the Austrian-born) have the highest R-squared values, 0.97 and 0.91, respectively, demonstrating very strong model fits. These are followed by Graph (c) (Inflows Model) with a value of 0.8, also indicating a strong fit. Graph (b) shows an R-squared value of 0.5, and Graph (a) has a value of 0.3, both suggesting moderate model fits.

The Index coefficient measures the impact of vulnerability on the growth rate of MST. For model (a) (Total Mobility), a small, negative coefficient and non-significant p-value (0.388) suggest no significant impact. In model (b) (Outflows), a negative coefficient with a significant p-value (0.013) indicates that vulnerability significantly reduces outflow growth rates. Model (c) (Inflows) shows a positive but non-significant coefficient (p-value = 0.299), indicating no significant effect. For Graph (d) (international migration for the foreign-born), the index coefficient is negative but not significant (p-value = 0.5654209), suggesting no meaningful impact. In Graph (e), the vulnerability variable has a negative, marginally significant coefficient (p-value = 0.079), indicating some influence, though less than the overall beta-convergence effect.

Overall, while vulnerability significantly reduces outflow growth rates, it does not significantly impact the growth rates of total mobility or inflows, implying that regions with higher vulnerability are experiencing slower outflows, but vulnerability does not substantially affect total mobility or inflows.

When looking at the individual NUTS 3 regions in the graphs, the analysis of the beta-convergence graphs reveals that the NUTS 3 regions tend to converge over time towards the low vulnerable regions (low and medium-low level). The analysis also shows several key outliers, points that deviate from the overall trends in the plots, offering insights into the migration dynamics of specific regions. In the graph of Total Mobility (Graph a), three outliers stand out: AT223 (Östliche Obersteiermark), AT334 (East Tyrol), and AT333 (Tiroler Oberland). AT223, with a high initial MST value around 66% and a relatively high growth rate close to 1.012, has continued to grow significantly despite its already high mobility. This suggests that AT223 has maintained or even increased its migration share of turnover. In contrast, AT334, which also started with a high MST value around 77 %, shows a stagnation or slight decrease in mobility, with a growth rate below 1.000. AT333, with a lower initial MST value around 62% and a growth rate below 1.004.

In the graph of Outflows (Graph b), the outliers AT221(Graz) and AT226 (Westliche Obersteiermark) are notable. AT221, with a moderate initial outflow value around 32% and a very high growth rate around 1.005, has significantly increased its outflows. Conversely, AT226, with a moderate initial outflow value around 36% and a very low growth rate below 0.990, shows a decrease in outflows.

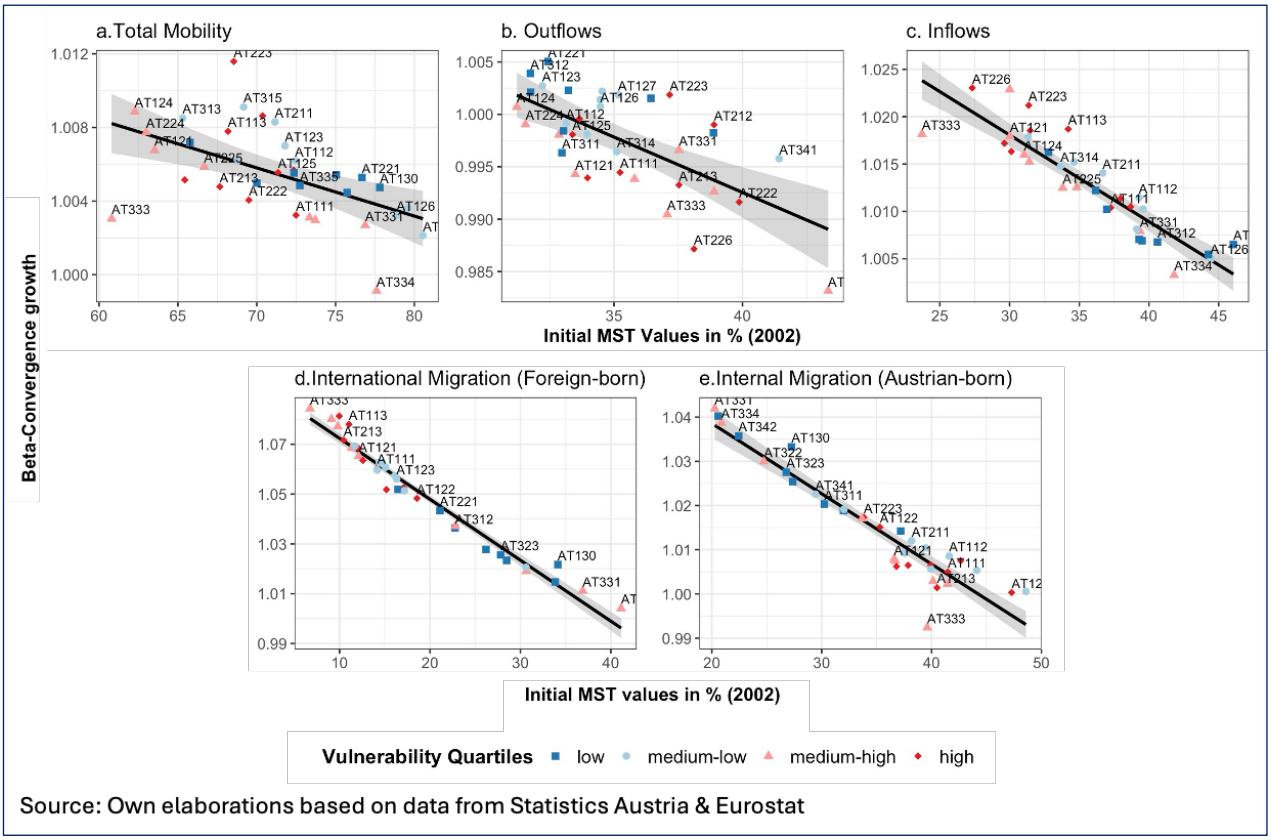
In the graph of Inflows (Graph c), the outliers AT223 (Östliche Obersteiermark) and AT334 (Tiroler Oberland) are again prominent. AT223, with a moderate initial inflow value around 31% and a very high growth rate around 1.021, has significantly increased its inflows, similar to its performance in total mobility. This indicates that AT223 is attracting more migrants over time. On the other hand, AT334, with a moderate initial inflow value around 41% and a growth rate close to 1.000, shows stagnation in inflows.

Graphs (d) and (e), which analyze migration patterns by country of birth, show minimal outliers, indicating a consistent convergence trend among most regions. The notable exception is AT333 (Tiroler Oberland) in Graph (e), representing internal migration for the Austrian-born, which starts with a high initial MST value of 40% and shows almost no change over time.

General observations highlight that AT333, AT223 and AT334 appear as outliers across multiple graphs, suggesting they have unique regional characteristics affecting migratory movements. The vulnerability quartiles, indicated by the colors and shapes, show that regions with high and medium vulnerability (red diamonds and pink triangles) generally exhibit higher growth rates, suggesting these regions all overall converging towards the same development as the low vulnerable regions. These regional insights are helpful to understand the diverse migration dynamics and regional disparities and underly the importance to study regional differences in MST and its components as the speed of change clearly varies.

Figure 17: Beta Convergence in MST Components

According to NUTS 3 Regions in Austria over time



Source: Own elaborations based on data from Statistics Austria & Eurostat

5. DISCUSSION

This chapter discusses the extent to which the findings of this thesis address the two research questions outlined in the introduction: (1) How does migration contribute to population dynamics in Austria at national and regional level, and how do these contributions differ by country of birth (native and foreign-born populations) in the period from 2002 to 2022? (2) How does the contribution of migration, differentiated by country of birth, vary across regions in Austria depending on their socio-economic vulnerability? Furthermore, while answering the research questions this chapter simultaneously places the findings of this thesis within the context of previous research presented in the literature review.

(1) How does migration contribute to population dynamics in Austria at national and regional level, and how do these contributions differ by country of birth (native and foreign-born populations) in the period from 2002 to 2022?

To answer the first part of research question one regarding how migration contributes to population dynamics in Austria at a national level, this study draws on both historical literature (Biffl, 2024; Fassmann & Reeger, 2008; Rupnow, 2017) and the findings of this thesis. Historically, Austria shifted from being characterized by emigration until 1950 to becoming a country of immigration, driven by labor market demands and responses to humanitarian crises. Key recent events, such as the influx of refugees from Syria, and Ukraine, along with "guest worker" agreements and EU free-movement policies, have significantly shaped these migration trends. Consequently, the proportion of the foreign-born population in Austria increased from 13% in 2002 to 20% in 2022, reflecting contributions from both EU member states and countries involved in guest worker agreements and those affected by humanitarian crises.

Building on the systematic categorization of migration policies outlined by Fassmann & Reeger, (2008) future research could benefit from incorporating insights from the DEMIG-QuantMig project (Schreier et al., 2023) to further categorize recent decades, starting from 2002. The findings of this study suggest that Austria is entering a new phase marked by more complex and tailored migration policies, reflecting the increasing reliance on international migration to drive population changes.

This shift is further highlighted by the intersection of significant historical events, the aging native-born population with low birth rates, and the higher proportion of foreign-born individuals within the working-age segments, as detailed in Chapter Three. These factors have collectively influenced the Population Turnover Rate in Austria from 2002 to 2022, demonstrating the critical role of migration in shaping the country's demographic landscape.

Furthermore, the PTR and MST data from 2002 to 2022 highlight the influence of migration on demographic dynamics. Notably, the Austrian PTR and MST values show peaks during significant EU accession years (2004, 2007, 2013) and humanitarian crises (2015, 2021), emphasizing the correlation between migration and demographic dynamics. The pandemic year 2020 marked a notable decline, aligning with global trends. The relationship between historical events and demographic changes becomes empirically evident reinforcing the argument posed by Billari (2022), which emphasizes the necessity of adopting a fast-paced demographic perspective and applying PTR and MST methods for a more comprehensive understanding of demographic changes.

The national-level results, compared to Billari's (2022) analysis, show that Austria experiences faster demographic changes than the European average, primarily driven by international migration. Between 2015 and 2020, Austria's average PTR was 48‰, notably higher than the European average of 39.5‰ and similar to the African PTR of 47.6‰, indicating a rapid demographic shift. During the same period, Austria's average MST was 59.8%, exceeding the 50% threshold and the European and African averages of 45% and 16.8%, respectively.

The development of the Austrian MST over time aligns with patterns observed in Billari's (2022) analysis of Germany and Italy, where MST peaks in 2007, 2013, and 2015 are followed by a significant decline in 2020 due to the COVID-19 pandemic. While Germany's MST increased from 48% in 2002 to 65% in 2015, Austria exhibited a similar pattern, with MST rising from 54% in 2002 to 65% in 2015. In contrast, Italy's MST remained below 42% throughout the same period. In contrast, Spain exhibited lower PTR levels, ranging from 30 to 40‰ between 2002 and 2021, with peaks occurring in different years than Austria (Damoun et al., 2024). Spain as well as the other countries mentioned also saw declines in PTR and MST during the COVID-19 pandemic in 2020, demonstrating the impact of global events on migration trends. Additionally, Billari notes that

smaller countries with populations under 15 million, such as Austria, tend to have an average MST of around 50%, a finding corroborated by this study.

However, this study primarily focuses on the 21st century due to the limited availability of longer historical time series data that would capture the diverse history of migration to and from Austria. Billari's work (2022) on Germany and Italy, for example, covers events dating back to 1915, highlighting the demographic impacts of major historical events such as the Great War, the Spanish flu pandemic, post-World War I emigration, and the reunification of Germany. In contrast, the Austrian analysis relies exclusively on more recent, high-quality register data, reflecting the evolution of data collection methods by Statistics Austria, as discussed in the data and method chapter. Future research could benefit from examining earlier migration policies, such as Austria's guest worker agreements and migration quotas, as well as, differentiating by country of birth to gain a better understanding of the long-term demographic impacts of historical events in Austria.

This study extends the application of MST and PTR methods by analyzing these metrics according to country of birth. The findings align with Billari's conclusions that demographic processes can exhibit both "fast" and "slow" dynamics simultaneously. Specifically, the PTR for the native-born population during the period 2002-2022 shows low values, ranging between 14‰ and 8‰, with a decreasing trend over time. This slow pace of demographic change can be attributed to the influence of birth and death rates in a post-transition demographic context. In contrast, the PTR for the foreign-born population ranges between 20‰ and 48‰, displaying an increasing trend primarily driven by international immigration.

Differentiating by country of birth is crucial when analyzing PTR and MST at the NUTS 3 level, as it reveals Austria's regional heterogeneity and directly addresses how migration impacts population dynamics by birth origin. This pioneering study for Austria, relying solely on its findings, capturing the distinct demographic patterns of foreign-born and Austrian-born populations. It shows that international migration has become a key driver of population change, contrasting with past trends. Additionally, Austria's population pyramids from 2002 to 2022 highlight a shift toward an aging population, presenting challenges for healthcare, pensions, and the labor market. Immigration has been essential in mitigating these effects, maintaining a balanced working-age population and supporting the country's economic stability.

The average PTR values analyzed across three five-year periods show that in all NUTS 3 regions, the PTR was above 55‰, and in the period 2015-2019, PTR values exceeded 60‰ in all regions except East Tyrol (58‰). This indicates a generally fast demographic pace across the regions. Furthermore, all regions exhibit MST values above 60% over the three five-year periods, highlighting the significant role of both internal and international migratory movements in shaping regional population changes. Although the overall trend shows increasing average PTR and MST values, these measures vary considerably across Austria's NUTS 3 regions, reflecting diverse regional experiences with migration. Urban centers such as Vienna, Graz, and the Vienna environs consistently emerge as migration hotspots, with the highest PTR and MST values, reflecting their role as key destinations for both international and internal migrants. Conversely, regions like East Tyrol**,** Tyrolean Oberland, and Mostviertel-Eisenwurzen have lower values, indicating slower demographic change.

Historical events such as the EU enlargements in 2004 and 2007, and the humanitarian crises in 2015 and 2022, disproportionately impacted regions like Vienna (AT130)**,** Außerfern (AT331), and Innsbruck (AT332) in Western Austria (AT3), which show the highest international MST values over the period observed (46.67% to 52.27%). In contrast, regions in Southern Austria (AT2) and Eastern Austria (AT1), such as Western and Southern Styria (AT225, AT226), and Weinviertel (AT125), exhibit lower international MST values (18.63% to 22.51%).

The analysis of internal MST shows that the Austrian-born population is more mobile than the foreign-born population in all NUTS 3 regions, with the trend generally decreasing over time. Regions in Eastern Austria, such as Wiener Umland-Nordteil (AT121) and Weinviertel (AT125), have the highest internal MST values, ranging between 54.70% and 58.70%, which is primarily due to internal migration of the Austrian-born population. In contrast, the regions in western Austria, including Außerfern (AT331) and Rheintal-Bodensee (AT342), have lower internal MST values, ranging from 31.56% to 34.82%. These results underline the different effects of internal migration patterns between the Austrian-born and foreign-born population in Austria's NUTS 3 regions.

(2) *How does the contribution of migration, differentiated by country of birth, vary across regions in Austria depending on their socio-economic vulnerabilty?*

To further examine the demographic differences between Austrian-born and foreign-born populations at the regional level, socio-economic factors and determinants of demographic changes were analyzed to create a composite vulnerability index for the NUTS 3 regions. According to the literature review, Austria excels in socio-economic indicators such as GDP growth, low unemployment, and high tertiary education rates at the national level. In terms of GDP development, Austria ranks among the highest within the OECD. Moreover, income inequality in Austria is relatively low, largely due to substantial public transfer redistribution, which helps maintain a relative poverty rate well below that of many other OECD countries (OECD, 2024). The findings on demographic trends clearly indicate that population growth in Austria has been primarily driven by immigration rather than natural increase.

Given the absence of a universal measure of vulnerability, it is valuable to compare the performance of Austrian regions according to different vulnerability metrics. The results of this study, which focus on socio-economic vulnerability in the context of migration, indicate that the least vulnerable regions are predominantly located in the north of the country and are generally urban NUTS 3 regions. In contrast, regions with medium to high vulnerability tend to be in central Austria and are more often rural areas. These findings partly align with the results presented by the European Commission et al. (2023), which identified less vulnerable areas in the center of the country, while more vulnerable regions were found in the south, Vienna, and one federal state in the west.

When comparing the findings for Austria with the study by Damoun et al. (2024) on the Spanish case, the latter exhibits more distinct geographical patterns. High and medium-high vulnerability NUTS 3 regions in Spain are typically located in the west of the country, while medium-low and low vulnerability regions are found in the east and on the islands. There is also a noticeable correlation between urban areas with strong MST performance and lower vulnerability. However, the Spanish results also differ from those reported by the European Commission et al. (2023), which placed the least vulnerable regions in northern Spain, while the most vulnerable regions were identified in the south, with medium-high vulnerability areas in the center, west, islands, and northeast.

These discrepancies can be attributed to the different dimensions that comprise the vulnerability index. In the study by the European Commission et al. (2023), environmental and political dimensions are included, but the correlation with international and national migration movements is not examined for Spain and Austria. Additionally, the study by the Commission focuses primarily on NUTS 2 regions. In contrast, both the present study and the study on Spain include similar dimensions and indicators, explicitly correlating them with internal and international migration flows and focusing on NUTS 3 regions. The comparison between this study, the Spanish case and the work of the European Commission et al. (2023) is still relevant as it shows that vulnerability can vary depending on the indicators considered. This highlights the need for a more comprehensive approach that incorporates multiple dimensions of vulnerability in order to accurately capture the dynamics of migratory movements and their impacts.

The results of this study indicate that low-vulnerability areas in Austria have a higher share of international immigration among the foreign-born population, with a consistent increase over time, peaking at 27% in 2022. In contrast, high-vulnerability regions had lower shares, remaining below 16% until 2021 and peaking at 18% in 2022. For internal migration, Austrian-born individuals showed higher migration levels in high and medium-high vulnerability regions (18-20%) compared to low-vulnerability areas (below 15%). Similarly, in Spain, low and medium-low vulnerability regions consistently had higher shares of international immigration among the foreign-born population, ranging from 11-31%, with peaks in 2005 and 2019. Internal migration patterns were also similar between Austria and Spain, with higher shares in medium and high-vulnerability regions (15-25%) and lower shares in low-vulnerability regions (below 15%).

Overall, the peaks and lows of migratory movements in Spain and Austria show notable differences, except for a decline in both countries in 2020 due to the COVID-19 pandemic. This reflects the varying impact of historical events on demographic changes. Unlike Austria, Spain's population dynamics were not significantly affected by the accession of Eastern European countries, and the humanitarian crises in Syria and Ukraine had different impacts on the two countries. These findings emphasize the importance of examining rapid demographic changes and how historical events can influence population dynamics differently. However, both countries exhibit similar migration patterns when analyzed at the NUTS 3 level according to socio-economic vulnerability levels.

The beta-convergence analysis for NUTS 3 regions in Austria considering vulnerability levels, indicates a significant convergence trend in migration dynamics between 2002 and 2022, influenced by both the type of migration and regional vulnerability. Five key scenarios were analyzed: total mobility, outflows, inflows, international migration of foreign-born and internal migration of Austrian-born. Overall, negative beta coefficients across all scenarios suggest that regions with lower initial migration rates are catching up with regions more influenced by migratory movements. This trend is most pronounced in international migration for the foreign-born population and internal migration for the Austrian-born population, as evidenced by the strong model fits in these scenarios. In contrast, total mobility, inflow and outflow models show moderate convergence, indicating varied dynamics across different migration types.

Regions with varying vulnerability levels displayed different migration growth patterns. Low-vulnerability regions exhibited higher international immigration growth, while high-vulnerability regions experienced slower outflow growth, suggesting these areas are losing fewer residents. The Index coefficient analysis indicated a significant negative impact of vulnerability on outflow growth, but no significant effect on total mobility, inflows, international immigration of foreign-born and internal migration of Austrian-born, highlighting the differential role of vulnerability. Notably, specific NUTS 3 regions, such as Östliche Obersteiermark (AT223), Tiroler Oberland (AT334), and Osttirol (AT333), emerged as outliers in the beta-convergence analysis, displaying distinctive migration and vulnerability patterns. Both AT333 and AT334 exhibit medium-high vulnerability levels and experienced less than a 5% increase in their foreign-born population from 2002 to 2022. In contrast, AT223, with high vulnerability, saw an increase of approximately 7.5% in its foreign-born population. Östliche Obersteiermark showed significant growth in both inflows and total mobility, indicating a rising attraction to migrants, whereas Tiroler Oberland exhibited stagnation or decline in these metrics. Graz (AT221) experienced a notable increase in outflows, while Westliche Obersteiermark (AT226) saw a decrease, highlighting contrasting migration dynamics within these regions.

The case of Osttirol (AT333) is particularly interesting, as it exhibits a high beta-convergence growth rate in the scenario for international migration of the foreign-born population. This indicates significant relative growth from a low starting point, even though the absolute increase over the period was among the lowest (less than 5%). While AT333 is catching up with other regions in

relative terms, its initial low percentage of foreign-born residents means that even small absolute increases result in high growth rates. The region's medium-high vulnerability status may also limit its attractiveness, contributing to modest migration flows despite this relative growth. This highlights the importance of considering both absolute and relative changes when analyzing migration trends.

These findings underscore the importance of considering both migration type and regional vulnerability when analyzing migration patterns and regional convergence. The observed convergence trends, alongside the identification of outlier regions, suggest that migration dynamics within Austria are becoming more homogenized over time, although certain areas continue to experience distinctive trends. The comparison with similar studies, such as the work of Damoun et al.(2024) on Spain, further supports the presence of convergence across various contexts, with Austria showing comparable negative beta coefficients, thus reinforcing the broader applicability of these findings.

6. CONCLUSSION & OUTLOOK

The primary objective of this thesis was to comprehensively analyze how migration contributes to population dynamics in Austria over time, using the Population Turnover Rate and Migration Share of Turnover at both national and regional levels. The analysis distinguishes between the contributions of Austrian-born and foreign-born populations to capture trends and any divergent dynamics. Furthermore, beta convergence analysis was employed to assess whether the impact of migration has developed favorably across Austria's NUTS 3 regions, depending on their socio-economic vulnerability over the past two decades.

To the best of available knowledge this thesis is for the first time employing the innovative approach of "fast demography" in analyzing the PTR and MST within the Austrian population context. In line with the study by Damoun et al. (2024), it expands the analysis to compare changes between foreign-born and Austrian born populations and examines regional differences at the NUTS 3 level, methods that have not been previously explored in the Austrian context.

The impact on regional population dynamics is assessed for both international and internal migration to provide a holistic insight into the demographic transformation that Austria's regions are experiencing during this era of "fast demography" driven by increasing levels of international migration. Understanding the differing roles of migration among native-born and foreign-born populations is particularly important in Austria, a country with one of the highest percentages of foreign-born residents in both the EU and among OECD countries and characterized by the uneven distribution of these populations at the subnational level, NUTS 3 level.

Five main conclusions can be drawn from the findings of this thesis:

First, regarding methodology and data, the PTR and MST methods are effective for measuring the contribution of migratory movements to population dynamics over time. These methods effectively capture the speed of population change and identify whether migration or natural changes are the primary driving factors. As highlighted by Billari (2022), the effectiveness of these methods depends significantly on the availability and quality of data. In this study, mainly datasets from Statistics Austria were utilized and these were of high quality, being publicly accessible and showing minimal discrepancies when the demographic balancing equation was applied.

However, challenges were encountered in data compilation due to the varying platforms and levels of data availability (e.g., some information was provided at the municipal level but not at the NUTS

3 level). These challenges were addressed through a harmonization process of municipal changes over time, resulting in the development of a useful R-code for harmonizing municipal changes from 2002 to 2022 that can be used in future research.

Second, at the national and regional level, international immigration from foreign-born individuals significantly and increasingly contributes to population dynamics in Austria, as evidenced by the PTR and MST results over time. High migration events, such as the Syrian and Ukrainian refugee crises, appear to accelerate demographic changes, making "fast demography" more prominent across all regions, including the most vulnerable ones. These findings align with the conclusions drawn by Billari (2022), demonstrating that "fast demography" complements "slow demography." This is highlighted by the contrasting results: the foreign-born population exhibits rapid demographic changes, as indicated by higher PTR and MST values, while the native-born population shows slower, more constant, and declining PTR values. The results of this thesis further substantiate that both fast and slow demography are consequences of historical events that shape demographic changes, underscoring the importance of regularly applying these methods to capture the ongoing demographic evolution accurately.

Third, the differentiated regional analysis highlights that region-specific strategies are crucial to addressing the distinct demographic and migration challenges faced by various regions in Austria. The diverse behaviors observed across NUTS 3 regions, such as the differences between low-vulnerability regions like Vienna, Graz, and Linz-Wels, and medium to high-vulnerability regions like Weinviertel and Osttirol, suggest that a one-size-fits-all policy approach may not be effective. Low-vulnerability regions may face challenges related to managing high population density, providing adequate infrastructure, and integrating a growing number of immigrants. In contrast, medium to high-vulnerability regions may struggle with retaining residents, attracting new migrants, and addressing socio-economic disparities. These variations emphasize the need for tailored regional policies that can effectively respond to the specific needs and challenges of each region.

Fourth, socio-economic convergence of regions at the national level should be understood not only in terms of migration's significant role in population changes but also as a framework for analyzing the relationship between regional convergence and divergence. As demonstrated in this study, such analysis requires examining the interactions between various demographic, economic, and social factors that influence population dynamics. The results of the beta

convergence analysis further support the concept of "fast demography," illustrating how NUTS 3 regions are gradually catching up and converging over time, particularly regarding international immigration.

Fifth, this thesis goes beyond the initially stated objective of focusing on national and regional developments in Austria and also provides a comparison of the Austrian case with other European cases, showing strong similarities especially with the Spanish case studied by Damoun et al. (2024). In both cases, higher immigration levels of foreign-born individuals are associated with regions of lower vulnerability, suggesting that, as characterized in this study, medium-low and low vulnerability regions are more likely to attract higher levels of migration, while medium-high and high vulnerability regions may not. Considering the demographic shifts previously mentioned, with the Austrian-born population aging and the foreign-born population playing a crucial role in maintaining demographic balance by providing more individuals in the working-age population, there is a clear need for policy-driven efforts to encourage stronger convergence across regions to attract migration. Such policies could help distribute the benefits of migration more evenly and support regional development and economic stability.

This study acknowledges certain limitations, including the need for analysis over longer historical periods to gain a more robust understanding of Austria's migratory movements. Additionally, further research is required to better understand the implications of migratory patterns and the distribution of foreign-born and Austrian-born populations across different NUTS 3 regions, which could inform targeted regional development strategies. Future research could extend the analysis using PTR, MST, and convergence methods to explore different types of migration, such as labor migration and migration resulting from humanitarian crises, both of which have been significantly shaped by policy interventions in Austria.

The importance of regional analysis is underscored by the findings in this thesis, which show significant variations in migration’s contribution to population turnover across Austria's regions. Conducting more localized analyses at the municipal or political district level could offer detailed insights into migration dynamics, differentiating between rural and urban areas and identifying specific patterns. Such localized understanding is essential for designing targeted, context-specific policies that address the unique demographic and socio-economic challenges faced by

different municipalities, enabling more effective strategies to manage migration and its impact on population dynamics.

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8. APPENDIX

8.1 ABSTRACT IN ENGLISH

This thesis examines the role of migration in Austria's population dynamics from 2002 to 2022 using Population Turnover Rate and Migration Share of Turnover methods, as applied by Billari (2022). With over 20% of Austria's population being foreign-born, the study highlights how international migration drives demographic changes at both national and regional levels. By extending Billari's approach to include detailed analysis by country of birth, at the NUTS 3 regional level, and incorporating a socio-economic vulnerability index for the regions, the thesis reveals a convergence trend in regional dynamics.

8.2 KURZFASSUNG

In dieser Arbeit wird die Rolle der Migration in der österreichischen Bevölkerungsdynamik von 2002 bis 2022 anhand der von Billari (2022) angewandten Methoden der *Population Turnover Rate* und des *Migration Share of Turnover* untersucht. Da mehr als 20 % der österreichischen Bevölkerung im Ausland geboren wurden, zeigt die Studie, wie die internationale Migration demografische Veränderungen sowohl auf nationaler als auch auf regionaler Ebene beeinflusst. Durch die Erweiterung des Ansatzes von Billari um eine detaillierte Analyse nach Geburtsland auf der regionalen Ebene NUTS 3 und die Einbeziehung eines sozioökonomischen Vulnerabilitätsindex für die Regionen zeigt die Arbeit einen Konvergenztrend in der regionalen Dynamik auf.

8.3 RESUMEN

Esta tesis examina el papel de la migración en la dinámica demográfica de Austria de 2002 a 2022, utilizando los métodos del *Population Turnover Rate* y *Migration Share of Turnover* aplicados por Billari (2022). Con más del 20% de la población austriaca nacida en el extranjero, el estudio evidencia como la migración internacional impulsa los cambios demográficos tanto a nivel nacional como regional. Al ampliar el enfoque de Billari para incluir un análisis detallado por país de nacimiento, a nivel regional NUTS3, e incorporar un índice de vulnerabilidad socioeconómica para las regiones, la tesis revela una tendencia de convergencia en la dinámica regional.

8.4 AUSTRIAN NUTS 3 REGIONS BY CODE & NAME

Code	Name
AT111	Mittelburgenland
AT112	Nordburgenland
AT113	Südburgenland
AT121	Mostviertel-Eisenwurzen
AT122	Niederösterreich-Süd
AT123	Sankt Pölten
AT124	Waldviertel
AT125	Weinviertel
AT126	Wiener Umland-Nordteil
AT127	Wiener Umland-Südteil
AT130	Wien
AT211	Klagenfurt-Villach
AT212	Oberkärnten
AT213	Unterkärnten
AT221	Graz
AT222	Liezen
AT223	Östliche Obersteiermark
AT224	Oststeiermark
AT225	West- und Südsteiermark
AT226	Westliche Obersteiermark
AT311	Innviertel
AT312	Linz-Wels
AT313	Mühlviertel
AT314	Steyr-Kirchdorf
AT315	Traunviertel
AT321	Lungau
AT322	Pinzgau-Pongau
AT323	Salzburg und Umgebung
AT331	Außerfern
AT332	Innsbruck
AT333	Osttirol
AT334	Tiroler Oberland
AT335	Tiroler Unterland
AT341	Bludenz-Bregenzer Wald
AT342	Rheintal-Bodenseegebiet

Source: European Commission, 2022b

8.5 CONDITIONAL BETA CONVERGENCE OUTPUT TABLES

a. Conditional Beta Convergence: Inflow Model				
Model Coefficients (Estimation Method: OLS)				
	Estimate	Std. Error	T Value	Pr (>|t|)
Alpha	1,17E-01	0,011973447	9,7393710	4,3087E-11
Beta	-2,94667	0,003188701	-9,2409790	1,5079E-10
Index	4,55E+02	0,000431461	1,054777	2,99E-01
Lamda	1,50E+03	NA	NA	NA
Halflife	4,63E+08	NA	NA	NA
Model Summary:				
	Estimate	F-value		Pr (>|t|)
R-Squared	0,8018768	6.475.784		5,64E-06

b. Conditional Beta Convergence: Outflow Model				
Model Coefficients (Estimation Method: OLS)				
	Estimate	Std. Error	T Value	Pr (>|t|)
Alpha	0,113728487	0,026644645	4,268343	0,00016387
Beta	-0,0316042	0,007605711	-4,155324	0,00022593
Index	-0,00145532	0,000558282	-2,606792	0,01376451
Lamda	0,001605719	NA	NA	NA
Halflife	431,67399	NA	NA	NA
Model Summary:				
	Estimate	F-value		Pr (>|t|)
R-Squared	0,5229817	17,54169		7,1872E-06

c. Conditional Beta Convergence: Total MST Model				
Model Coefficients (Estimation Method: OLS)				
	Estimate	Std. Error	T Value	Pr (>|t|)
Alpha	8,9297E-02	0,022624342	3,94693	0,0004065
Beta	-1,949E-02	0,005236869	-3,72110	0,0007614
Index	-2,972E-04	0,000339828	-0,87466	0,3882765
Lamda	9,84E-04	NA	NA	NA
Halflife	7,04E+02	NA	NA	NA
Model Summary:				
	Estimate	F-value		Pr (>|t|)
R-Squared	0,3045278	7,005953		0,0029955

d. Conditional Beta Convergence: International Migration foreign-born				
Model Coefficients (Estimation Method: OLS)				
	Estimate	Std. Error	T Value	Pr (>|t|)
Alpha	0.183164135	0.0051987133	35.2325898	3.584970e-27
Beta	-0.046922010	0.0014953729	-31.3781336	1.320045e-25
Index	-0.000351191	0.0006046322	-0.5808341	5.654209e-01
Lamda	0.002402927	NA	NA	NA
Halflife	288.459511000	NA	NA	NA
Model Summary:				
	Estimate	F-value		Pr (>|t|)
R-Squared	0.9752193	629.6643		2.022142e-26

e. Conditional Beta Convergence: Internal Migration Austrian born				
Model Coefficients (Estimation Method: OLS)				
	Estimate	Std. Error	T Value	Pr (>|t|)
Alpha	0.187248821	0.0096703862	19.363117	3.109945e-19
Beta	-0.048136372	0.0028783775	-16.723439	2.245174e-17
Index	-0.001106811	0.0006101112	-1.814114	7.904663e-02
Lamda	0.002466675	NA	NA	NA
Halflife	281.004650364	NA	NA	NA
Model Summary:				
	Estimate	F-value		Pr (>|t|)
R-Squared	0.9192004	182.0208		3.300254e-18

Source for all tables: Own elaborations based on the output from the code done in the R-program, based on data from Statistik Austria and Eurostat