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*Demographics in Transition and the Evolving Economy: Trends,
Challenges and Opportunities*

João Miguel Pinto Ferreira

Project Work

presented as partial requirement for obtaining a Master's Degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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Demographics in Transition and the Evolving Economy: Trends, Challenges and Opportunities

by

João Miguel Pinto Ferreira

Project Work presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information Management, with a specialization in Knowledge Management and Business Intelligence.

Supervised by

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2023/2024

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism, any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

João Ferreira

Lisboa, 1st December 2024

ACKNOWLEDGEMENTS

First and foremost, I would like to take this opportunity to express my profound gratitude to my advisor, Professor Teresa Ferreira Rodrigues for all the invaluable guidance, patience, and support throughout this journey. Her expertise and encouragement were valuable assets toward the completion of this thesis.

To my parents, my brother, my grandparents, and my aunt, uncle and cousin, I am infinitely grateful for their continuous love, support, and belief in me. Your encouragement and understanding were my foundation, without which I could not have achieved this milestone.

Lastly, my heartfelt thanks go out to Catarina, for her kindness, for the encouragement she has given me, and for always being there whenever I most needed her. Her presence made this journey lighter and more meaningful.

ABSTRACT

Portuguese society is at a crossroads, requiring a proactive approach to address demographic and economic challenges while ensuring social well-being and sustainable development. This thesis examines the interplay between demographic trends and economic realities, highlighting key factors such as aging, migration, and labour market dynamics. It underscores the urgent need for Portugal to rethink traditional age-related benchmarks—early retirement, late retirement, and old age—and to develop a comprehensive age policy that aligns with the nation’s evolving demographic landscape. The analysis emphasizes the vital role of demographic data as a tool not only to understand current realities but also to anticipate future scenarios. Demographic trends are not fixed destinies; they present opportunities to address risks and transform potential threats into drivers of growth and resilience. This thesis advocates for policies that prioritize human development and quality of life for all residents, regardless of demographic shifts in volume, aging, geographical distribution, or societal behaviours. In the context of the growing adoption of Business Intelligence (BI) solutions worldwide, this project explores the development and implementation of a BI system using Power BI. Data from two distinct sources were extracted to feed into the data system, enabling the construction of a comprehensive dashboard. The dashboard incorporates analyses related to the resident and immigrant populations, employment and unemployment trends, as well as economic factors such as business creation and dissolution, and trade flows, including imports and exports. By leveraging these insights, the project aims to deliver a powerful tool for data-driven decision-making and to enhance understanding of the interplay between demographic and economic dynamics.

KEYWORDS

Business Intelligence; Data Visualization; Portugal; Demography; Economy

Sustainable Development Goals (SDG):



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LIST OF ABBREVIATIONS AND ACRONYMS

BI	Business Intelligence
DA	Data Analysis
DAX	Data Analysis Expressions
DV	Data Visualization
DW	Data Warehouse
EU	<i>European Union</i>
INE	<i>Instituto Nacional de Estatística</i>
NUTS	<i>Nomenclatura das Unidades Territoriais para Fins Estatísticos</i>
PBI	Power BI

1. INTRODUCTION

1.1. CONTEXTUALIZATION

“Demographic phenomena cannot be dissociated from their economic counterpart: the economy and demography interact, reinforcing each other in circle of cumulative causation.”

Castro, E. *et al*, 2020

Demography is an extremely important science for understanding how populations function worldwide, and its interconnection with the economic sector is evident, due to strong links between both vectors. The same occurs in Portugal. The process of industrialization is believed to be one of the major factors behind the regional differences that occurred in the two last centuries, contributing to the creation of a new order and geography of resources. This is due to the favoured establishment of industrial units in certain territorial regions of the country, thereby modifying internal mobility patterns. Through these two sciences, demography and economy, it becomes possible to understand global-level flows, and, in the Portuguese case, which will be one of the main focal points of analysis, to investigate how not only demography influences the economy but also how the economy contributes to the emergence of demographic changes (Peixoto, 2017; Góis, 2023).

Demographic changes are simultaneously a cause and a consequence of social, economic, and environmental dynamics. The economy and demography interact, reinforcing each other in circles of cumulative causality. Therefore, the existence of policies to address this dynamic is necessary. In this way, demographic dynamics condition economic development and influence levels of social well-being, mainly in regional terms (Rodrigues, 2021b).

Portugal carries within itself a noble history of victories, both demographic and economic. From the grandeur of the Age of Discoveries to internal instability and fragility, it faces today one of the most pragmatic population aging challenges in its history. Rodrigues, T. & Henriques, F. (2017) emphasize that the 20th century was rich in events that contributed to a phase of modernization and demographic, social, and economic changes. After the end of the Estado Novo and the establishment of the República in 1974, followed by Portugal's entry into the European Union (EU) in 1986, Portugal, along with other European countries, implemented policies to reformulate and revitalize their economies. However, in the present century, we have witnessed a decline in the sought-after balance between different age groups. According to Foresight Portugal 2030 (Ribeiro, J. 2021), the percentage of elderly individuals far surpasses that of children and young people, leading to the observation that "this also means that the replacement of the active and contributing population has not been ensured since 2010." This trend will not be solved in the next few decades, not even through positive migration balances, like the ones that have existed since 2019. However, in recent

years, the influx of many migrants and immigration has contributed to mitigating this trend, although still in a modest way, as these migratory movements are often unstable and, in some cases, temporary, with Portugal serving as a gateway to Europe. The issue affecting demography in Europe is neither new nor unknown, as cited by Castro, E. et al. (2020). However, the priority is to find strategies capable of mitigating the effects of demographic regionally and locally, at economic, political, and social levels, recognizing that demographic changes are both a cause and a consequence of these challenges.

The need for economic diversification in terms of government policy and private offer is imperative in the face of challenges such as unemployment and the high public debt to which we are currently exposed. Thus, innovation plays a vital role in pursuing a more prosperous future, allowing for a balance between gradual modernization and the preservation of tradition. With this initial framework and after establishing a correlation between Demography and Economy, we aim to further understand the different fluctuations over time, supported by theories and studies, using available data analysis and interpretation through the discipline of Business Intelligence (BI).

1.2. GOALS AND OBJECTIVES

Currently, there is a wealth of information available in the fields of demography and economics, yet the correlation between these two social sciences is often underestimated, and necessary solutions for existing shortcomings may not be readily apparent.

There is a lack of economic policies capable of attracting and retaining the population, both resident and migrant, as well as anticipating labour market needs by sector. Therefore, it is essential to analyse and project new policies, such as migration and integration policies, employment and education, natality, and family policies, to help combat their negative effects in national economic dynamics. One prominent issue is the aging phenomenon, especially noticeable in areas weakened by simultaneous declines in fertility and significant migration to other parts of the country, particularly towards the coast and urban centres.

As a result, it is crucial to create solutions and projections that demonstrate a positive impact on resolving these issues, as this situation influences Portugal's standing compared to other countries. The exploration aims to address several questions:

- What path should be followed to ensure an ideal balance between the economy and demography?
- What metric between economy and demography that is affecting the current Portugal's panorama?
- What is the impact of migration in the current situation of the country?
- How does the sectoral division of labour impact economy and demography?
- What policies can be implemented to effectively combat the existing problems?

1.3. STUDY RELEVANCE AND IMPORTANCE

Is a study focusing on the analysis of population in demographic and economic terms justified?

According to the most recent demographic data, population movements from the interior to the coast, from villages to urban centres, the general aging of the population, the inability to balance this demographic pyramid, and regional asymmetries between demography and economy are evident.

In this sense, the developed study sought to reflect on all these variables, highlighting the causes and effects of an unbalanced demographic pyramid, alongside an equally ambitious economy. It also aimed to reflect on migratory flows and underlying reasons for these movements, starting with the distribution of populations by region, employment and unemployment, and their relationship with geographical areas to which the data refer.

With the data presented and the proposed analysis, we aim to reflect on the antecedents of the present and outline guidelines and directions to counteract current evidence and pursue a balance between the various variables in the future.

1.4. PROJECT RESEARCH DESIGN

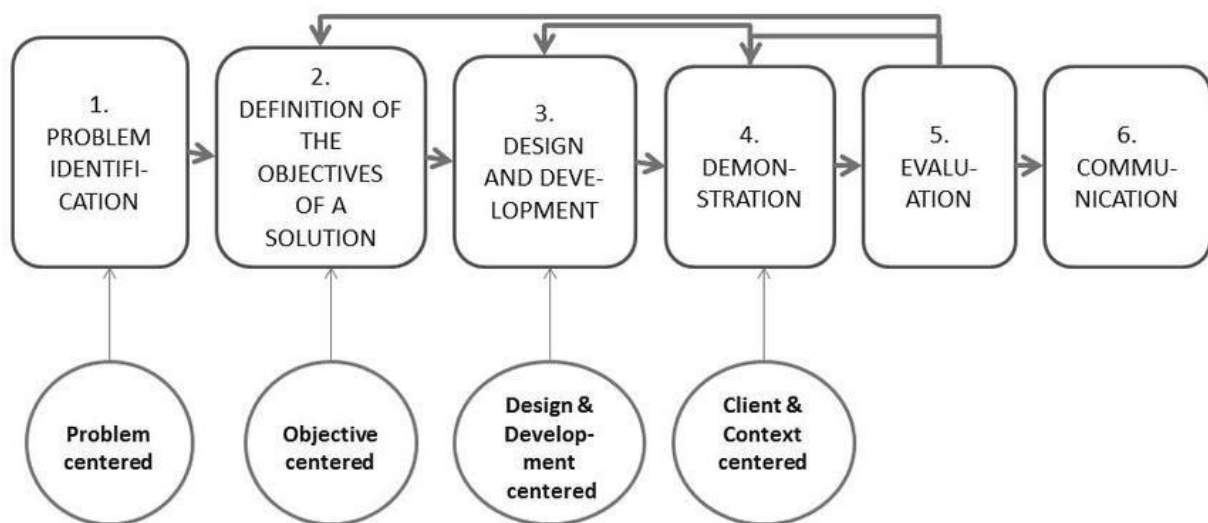


Figure 1 – DRSM Model
Source: Peffers, et al., (2007)

Bayazit, N. (2004) defines Design Science Research Methodology as a systematic inquiry whose goal is knowledge of, or in, the embodiment of configuration, composition, structure, value, and meaning in man-made things and system. The DSRM (Design Science Research Method) follows six steps and focuses on creating a novel artifact that addresses a defined

problem. This artifact not only provides a practical solution but also adds valuable insights to the existing knowledge around research.

To accomplish the pretended result, six phases will be implemented:

- (1) Problem Identification:** The current situation in Portugal regarding economic and demographic metrics, in their various aspects, has significant repercussions in areas such as population aging, regional population movements, unemployment, disinvestment, and others.
- (2) Definition of the objectives of a Solution:** The aim of the project is to analyse historical Portuguese data across various metrics to gain a concrete understanding of the current situation and to support the creation of policies that will improve it.
- (3) Design and Development:** A well-defined data workflow will be established, covering everything from the data source, ETL (Extract, Transform, Load) processes, to the creation of visualizations.
- (4) Demonstration:** During development, ongoing testing will take place to measure progress and ensure that the tool is meeting its objectives. Feedback will be gathered to identify necessary improvements and fine-tune the solution.
- (5) Evaluation:** Once the tool is completed, it will be evaluated to determine whether it successfully addresses all the goals. This step will involve analysing whether the dashboards meet the requirements and if any refinements or redesigns are necessary for optimal performance.
- (6) Communication:** Finally, the outcomes of this project will be formally communicated. This document will serve as the main resource to present the results and share the developed solution with the wider community.

2. LITERATURE REVIEW

2.1. DEMOGRAPHY AND ECONOMY: AN ANACHRONISTIC VISION

Until the 18th century, according to the path travelled throughout history and different moments identified on a continuous timeline, we observe a balance among various areas: population, economic, political, social, cultural, and religious. There seemed to be an apparent equilibrium where, because of controlling two variables—one positive through natural mortality increase and the other preventive through decreased birth rates—Malthusian theory prevailed. According to the economist who first proposed the relationship between demography and economy, "people with no constraints increase geometrically." Hence, when there is no control between demographic levels and the subsistence level of populations, the desired balance is disrupted. Therefore, this fragile balance was understood as something necessary, as "if the population were to grow exponentially, food resources would only grow in an arithmetic progression, inevitably leading to scarcity, hunger, and chaos" (quoted by Henriques, F., 2016).

According to certain historical elements, we observe different "stages" from the 18th century that extended through the 19th and 20th centuries, promoting what some theorists have identified as demographic transition. This theory examines and understands changes in demographic growth, whether natural or vegetative, based on variations in birth and death rates. Notestein (1929) opposed the Malthusian theory by analysing it from the perspective of the Industrial Revolution. The decline in mortality and birth rates in developed countries demonstrated a mutually causal relationship between population and economic development, where the latter was responsible for balancing the two variables. It leads us to believe that the correlation between economy and demography was reciprocal.

Through the Unified Growth Theory, Galor (2005) raises numerous questions about the evolution of growth, demography, and economics, seeking to clarify and challenge opposition to previously conceived ideas. Unlike Malthus, Galor argues that the most technologically advanced countries are not necessarily the most populous. On the other hand, contrary to Malthus's concept of constant per capita income values, Galor proposes growth at varying speeds.

Furthermore, Bloom and Canning (2003) considered that the economy and economic growth are dependent on changes in the age structure of the population. According to these authors, both a large percentage of youth and elderly individuals can contribute to a slowdown in economic growth, unlike a higher percentage of the working-age population. Concerning the youth, the situation is expected to be different, as "when that generation reaches working age, if employed productively, the country will experience an economic boost."

2.1.1 THE IMPACT AND IMPORTANCE OF DEMOGRAPHY AND ECONOMY IN TODAY'S SOCIETY

As we have already had the opportunity to observe, Demography and Economy are intricately related. A slight slowdown in population growth is expected, and consequently, a reduction in workforce participation rates, that is, the active population. This assumption will impact long-term economic growth and its composition. Therefore, we understand that determinants of long-term economic growth rate include, on one hand, workforce growth and, on the other hand, structural productivity growth. From the perspective of Demography, this workforce growth, coupled with an aging population, will be slower, thereby compromising long-term economic growth.

2.1.2. PORTUGUESE POSITION IN THE WORLD

According to the most recent data, at the end of 2023, the Portuguese population was around 10.6 million inhabitants, the highest number of residents ever recorded (INE, População residente ultrapassa os 10,6 milhões, Destaque, 18 de junho de 2024. Disponível em: 18ESTIMATIVAS POP. 2023_corrigeo.pdf). This fluctuation is entirely dependent on migrations, which have justified the increases observed today. There is also a high percentage of elderly individuals, ranking Portugal as the fourth most aged country in Europe, with birth rates insufficient to ensure generational renewal. However, the numbers we see today have been significantly influenced by a decrease in infant and juvenile mortality and an increase in average life expectancy.

In this new demographic profile, Portugal has few young people, many elderly individuals, and a substantial number of very elderly individuals. Additionally, there are observable trends of change in various societal areas, including education, health, and the labour market.

Concerning education, numerous changes have occurred, such as the democratization of education and universal access to schools regardless of gender. Even under these conditions, reducing the dropout rate has proven challenging, making the recruitment of qualified workforce a challenging task. In terms of health, the National Health Service has endeavoured to reduce disparities between different regions, reaching a larger number of people, facilitating early diagnosis, and reducing the budgetary burden on healthcare.

Regarding the labour market, conditions are slowly and gradually improving in Portugal. According to the following figure (Figure 2), we can observe that new challenges arise regarding the provision of basic public services, considering the evolution of the aging process and migration.

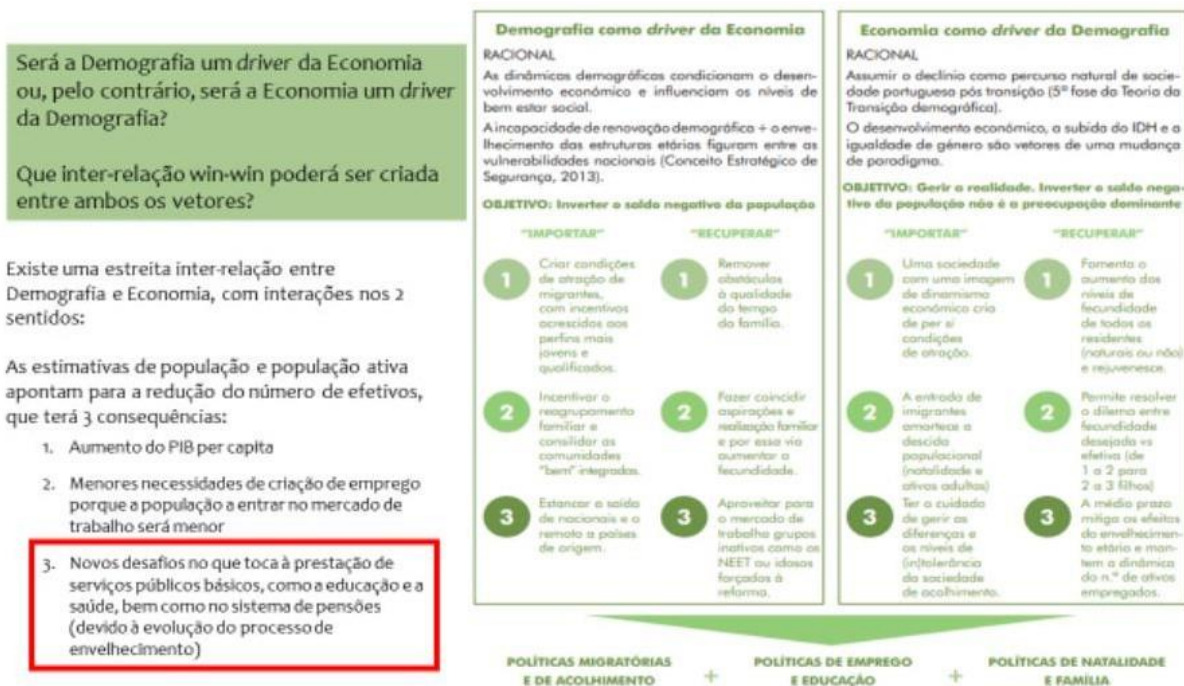


Figure 2 – Portugal. Demography or Economy?

Source: Rodrigues, T. (2021). FORESIGHT PORTUGAL 2030 – Volume 3, <https://gulbenkian.pt>

Figure 1 highlights that there is an underlying duality between demography and economy, primarily due to the emphasis placed on the objectives of each axis in reversing the negative population balance (Demography as a driver of the economy Vs. Economy as a driver of demography). This suggests that demographic growth does not always translate into economic growth, as not all the population in the country is part of the active workforce.

It is important to build a dynamic strategy that allows us to value and provide an institutional and societal response to sustain economic growth based on demographic expansion and also understand the impact of immigration in these metrics.

2.1.3. PORTUGUESE HISTORICAL PERSPECTIVE ON POPULATION AGING AND CHALLENGES TO FACE

Going back to the beginning of the last century, from the available records, we observe a period of population growth in our country, particularly from 1900 to 1911. This growth was interrupted around 1920 with the country's participation in the First World War. This trend was countered in the post-war period, during the 1940s. Between the 1940s and 1970s, we again witnessed a decrease in population due to the relocation of people to Portuguese colonies overseas and subsequent participation in the Colonial War.

Starting from 1974 with the implementation of democracy in the country and the abandonment of the overseas empire, there was slight growth until the 1980s, where another decline was recorded, continuing until the 1990s. There was a new increase in the population during the 1990s due to the increase in immigration flow and the aging population, the latter due to the increase in life expectancy.

More recently, according to the National Statistics Institute (INE), in 2022, there was an increase in the resident population in Portugal due to a positive migration balance, which exceeded the negative natural balance. The trend of demographic aging persisted due to the reduction in the young and active population and the increase in the number of elderly people.

According to the same publication, the resident population in Portugal was estimated at 10,467,366 people, resulting in an effective growth rate of 0.44% due to a natural growth rate of -0.39% and a migratory growth rate of 0.83%, as reflected in the following table.

População, indicadores e taxas	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
POPULAÇÃO												
População Média (N.º)	10 574 536	10 531 420	10 473 991	10 419 807	10 381 838	10 356 516	10 340 124	10 334 633	10 354 446	10 384 846	10 407 707	10 444 242
População em 31.XII (N.º) ^(a)	10 558 950	10 503 889	10 444 082	10 395 121	10 368 554	10 344 478	10 335 770	10 333 496	10 375 395	10 394 297	10 421 117	10 467 366
Relação de Masculinidade Total (N.º)	91,3	91,0	90,6	90,4	90,3	90,3	90,2	90,1	90,4	90,7	91,1	91,5
Saldo Natural (N.º) ^(b)	- 5 993	- 17 771	- 23 768	- 22 476	- 23 039	- 23 447	- 23 604	- 26 031	- 25 264	- 38 866	- 45 220	- 40 640
Saldo Migratório (N.º)	- 25 178	- 37 290	- 36 029	- 26 495	- 3 528	- 629	14 896	23 757	67 163	57 768	72 040	86 889
Variação Populacional (N.º)	- 31 171	- 55 061	- 59 797	- 48 971	- 26 567	- 24 076	- 8 708	- 2 274	41 899	18 902	26 820	46 249
Taxa de Crescimento Natural (%)	-0,06	-0,17	-0,23	-0,22	-0,22	-0,23	-0,23	-0,25	-0,24	-0,37	-0,43	-0,39
Taxa de Crescimento Migratório (%)	-0,24	-0,35	-0,34	-0,25	-0,03	-0,01	0,14	0,23	0,65	0,56	0,69	0,83
Taxa de Crescimento Efectivo (%)	-0,29	-0,52	-0,57	-0,47	-0,26	-0,23	-0,08	-0,02	0,40	0,18	0,26	0,44
Índices de Dependência (N.º)												
Total	51,9	52,3	53,0	53,5	53,9	54,6	55,2	55,8	56,6	57,3	57,9	58,4
Jovens	22,8	22,6	22,4	22,1	21,8	21,6	21,4	21,2	21,0	20,8	20,6	20,4
Idosos	29,1	29,7	30,6	31,4	32,1	33,0	33,8	34,6	35,6	36,5	37,3	38,0
Índice de Envelhecimento (N.º)	128,0	131,4	136,4	141,9	147,6	152,5	157,9	163,2	169,4	175,6	181,3	185,6
Idade mediana da população residente (Anos)	42,2	42,6	43,1	43,6	44,1	44,5	45,0	45,4	45,9	46,3	46,7	47,0
MIGRAÇÕES INTERNACIONAIS												
Imigrantes permanentes (N.º)	18 820	14 668	17 757	23 077	36 849	37 644	46 649	55 357	95 382	83 654	97 119	117 843
Emigrantes permanentes (N.º)	43 998	51 958	53 786	49 572	40 377	38 273	31 753	31 600	28 219	25 886	25 079	30 954
Emigrantes temporários (N.º)	56 980	69 460	74 322	85 052	60 826	58 878	49 298	50 154	48 821	42 323	40 904	40 763

Figure 3 – Population and demographical measures

Source: Instituto Nacional de Estatística (2023). Estatísticas Demográficas 2022

All projections indicate that population aging is one of the greatest challenges facing Portugal, as mentioned in the previous point (Fig. 3). As the sixth most aged country in the world, and according to Rodrigues, "there are fewer deaths, but there are even fewer births," and by 2050, "only one in eight people will be considered young, meaning they will be under 15 years old." We will then have lost a fifth of the population, and "neither migration nor increased births will be sufficient on their own to ensure the total increase in residents in Portugal."

We know with a high degree of certainty that we will be older, fewer, and different. We know that we may lose one-fifth of the current residents by 2040 (we will then be around 4.8 million, as many as we were in 1950), that the average age of the population will predictably continue

to increase (in this context, only 1 in 8 Portuguese will be young, there will be three times more elderly people than young people, and the working-age population will decrease by one-third, from the current 5.2 million to 4.6 million active individuals, similar to what existed at the beginning of World War II) (Figure 4).

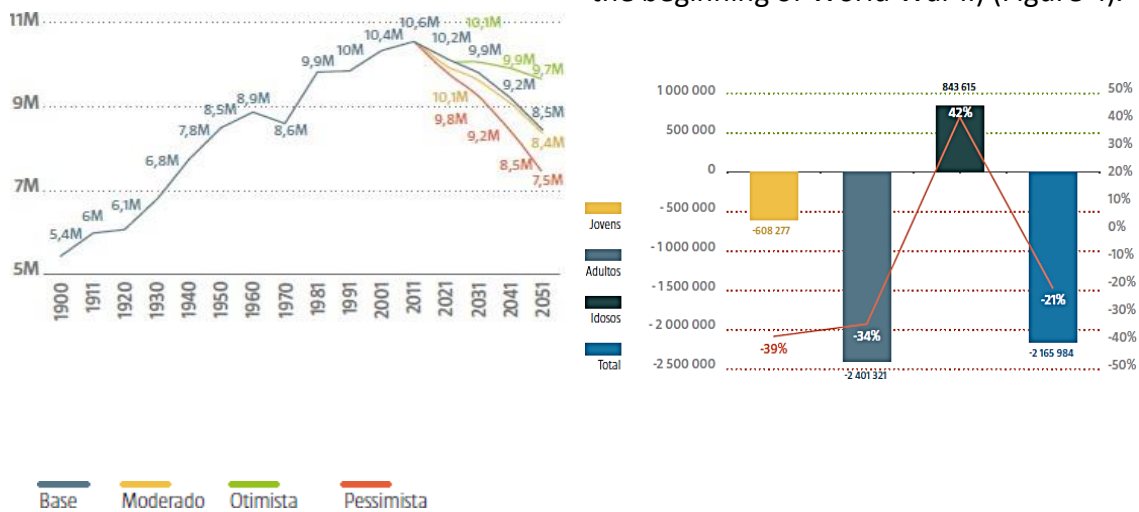


Figure 4 – Portugal. Prospective scenarios and variation in age groups (2011-2050) (M = millions)
Source: Rodrigues & Henriques, 2017

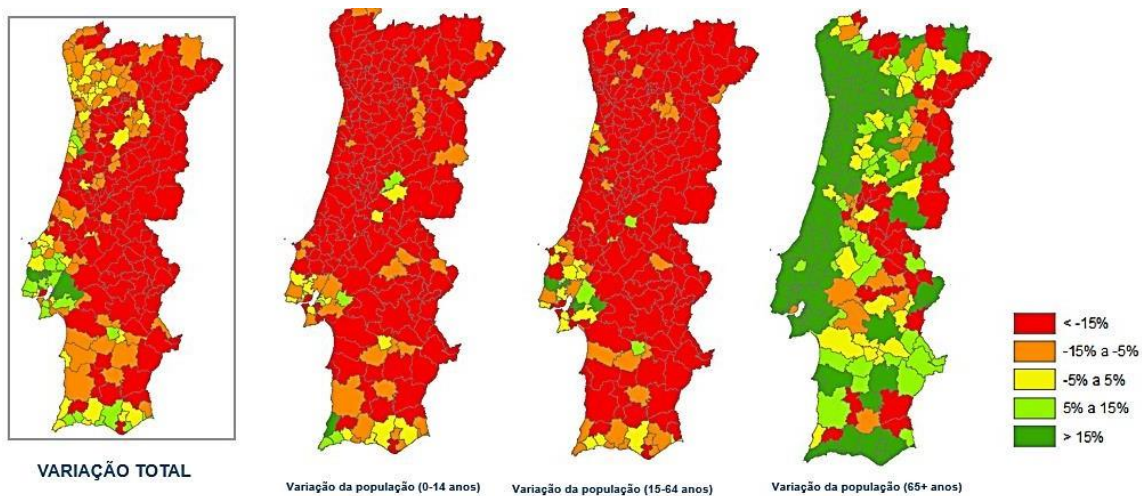


Figure 5 - Portugal. Regional dynamics of aging by age groups (2011-2040)
Source: Rodrigues et al, 2018b: 69

Nevertheless, we will continue to be different in regional terms (Figure 5). A generalized decrease is expected across the entire territory in the younger age groups (0-14 years) and in the working-age population (15 to 64 years), while the age group of 65 and older will grow in almost the entire territory. Portugal will maintain a trend of triple aging, with more elderly people, fewer young people, and increasingly older adults, a fact that will obviously have consequences for the organization of the social system, health, and even the security sector.

Elderly people living alone or with other elderly individuals will inhabit rural areas (where other functional groups lose population).

We must find ways to ensure that the expected population decline, and the continuation of this aging process does not compromise the levels of collective social well-being already achieved, or else create obstacles to its improvement. It is certain that the aging of age structures seems unavoidable today and has effects on fertility models, reaffirming the urgency of appropriate family support measures. It alters the volume of the workforce, increases the need to create elderly support services, reformulate the pension system, and rethink healthcare, in a society where family units are small and unstable, and where community solidarity networks, which recently replaced formal care, no longer function.

Next, we present the results of a scenario exercise on the possible future of the relationship between demographic dynamics, economic development, social sustainability, and equity by 2040. Scenario building is an important exercise in reflecting on areas where evolution seems uncertain, as is the case here. In this specific case, we identified five aspects whose occurrence seems very likely and three major uncertainties (Rodrigues, T. 2018).

The first five aspects are:

- Reduction or maintenance of the number of residents and changes in their age profile.
- Greater ethnic and cultural diversity, higher levels of education and professional training, better health, and greater consumption capacity.
- A dominant crisis rationality until the mid-2020s, aggravated by the effects of the current pandemic.
- Slight economic recovery after 2025, accompanied by restructuring of the labour market, which aims to reduce youth unemployment, especially among the less qualified.
- Gradual improvement in average levels of social well-being and partial reduction of regional disparities.

However, there are three uncertainties whose realization (or lack thereof) will be crucial and will influence the future characteristics of Portuguese society (Rodrigues, T. 2018):

- The ability to achieve economic recovery in the context of global economic instability may or may not be successful.
- The degree of success of measures taken at different levels and by different actors to ensure the improvement of human development indicators and collective social well-being.
- The capacity to change the logic of public and private policies, choosing between mitigating the undesirable effects of demographic aging, especially in the economic and social spheres, either by stimulating the economic (and contributive) sector through the importation of new human resources and/or the recovery of specific

groups, or by assuming a new future logic for Portuguese society based on new organizational and operational approaches.

How will each of these vectors evolve? Does demographic dynamics influence or is it influenced by economic dynamics? Demography and/or economy or social well-being? Is this well-being possible in a depressed demographic context? And in a context of economic volatility, a potential cause or consequence of social tensions? The intersection of these eight factors allows for the creation of four possible scenarios for the evolution of the Portuguese reality (Figure 6).

Scenario 1 is what we want to avoid. It is based on the hypothesis that Portugal continues for several more years immersed in an economic growth crisis, where the effort to resolve it overshadows any other goal. The enactment of measures in the realm of collective well-being would be merely occasional, and social priorities would be subordinated. In an economic reality that does not prioritize new solutions for contributory sustainability, the mitigation of labor shortages due to the aging population and, consequently, the lack of net contributors, would be addressed using conventional measures. Preventing population decline would become a priority, and to this end, Portugal would attempt to attract foreign residents, reduce the emigration of nationals, and create incentives to increase birth rates, although these would be sporadic and, therefore, ineffective.

Scenario 2 maintains the forecast of a recessionary economic outlook but admits the possibility of some investment in concerted socioeconomic policies, ensuring sufficient conditions to attract new residents (mostly low-skilled workers), reduce the departure of Portuguese people, and increase fertility rates, albeit without significant expenses, given the volatility of the economic environment.

In turn, Scenario 3 assumes that the coming decades will be marked by economic recovery. Assuming the inevitability of demographic aging, the main goal would be to improve well-being standards and make Portugal a country where everyone, regardless of birthplace, feels welcome. The fragility of this hypothetical reality lies in the lack of strategic vision in social policies, which diminishes the potential advantage of the existing conjunctural conditions.

Scenario 4 envisions the best possible future for a country where everyone, regardless of their origin, education, health status, or income, has reasons to want to live. We speak of a recovering Portugal, where a smaller but more diverse population, rich in cultural and identity aspects, benefits from concerted social and economic welfare policies tailored to the particularities of each age group and region, promoting high standards of quality of life.

It is possible to think that these scenarios may unfold sequentially, as we are talking about dynamic realities, and adopt a positive outlook on the future and our ability to ensure a better life for future generations than the one lived in the present. Thus, we can assume that by 2040, Portuguese society will evolve from the situation characterized in Scenario 1, which

seems to reflect, to some extent, our current reality, and gradually move through Scenarios 2 and 3 until finally achieving Scenario 4.



Manutenção da crise de crescimento económico, cujo esforço de resolução se sobrepõe a qualquer outro objetivo. A promulgação de medidas de bem-estar coletivo e prioridades de âmbito social são subalternizadas. A mitigação da falta de mão-de-obra e de contribuintes líquidos será feita recorrendo a medidas convencionais. Impedir o declínio populacional torna-se a prioridade. As soluções pressupõem atrair imigrantes, reduzir a emigração e criar incentivos para aumentar a natalidade. Medidas avulsos e ineficazes.



Mantém-se a previsão de conjuntura económica recessiva, mas existe algum investimento em políticas socioeconómicas concertadas, as quais permitem criar condições suficientes para atrair novos trabalhadores (a maioria pouco qualificados), reduzir a saída de portugueses e aumentar os níveis de fecundidade, embora sem gastos significativos, atendendo à volatilidade do ambiente económico.



Pressupõe que as próximas décadas sejam de retoma económica. Assume a inevitabilidade do envelhecimento demográfico. O grande propósito é melhorar os padrões de bem-estar e fazer de Portugal um país onde todos, independentemente do local de nascimento, se sintam bem-recebidos. A fragilidade desta hipotética realidade decorre na falta de visão estratégica na esfera das políticas sociais, que retira parte da vantagem potencial das condições conjunturais existentes.



Pressupõe uma conjuntura em recuperação económica, onde uma população menos numerosa e mais diversa beneficia de políticas concertadas de bem-estar social e económico, ajustadas às particularidades de cada grupo etário e região, e promotoras de padrões satisfatórios de qualidade de vida. Um país onde todos, independentemente da sua origem, formação ou rendimento, têm razões para querer viver.

Figure 6 – Portugal. Scenario of Social, Demographic and Economic Evolution (2024-2040)

Source: RODRIGUES, 2018

But societies do not change without changing their citizens. We must face the changes that Portuguese society will undergo in the coming decades. The predominant discourse continues to delegate the resolution of problems to political leaders. However, this responsibility involves employers, stakeholders, opinion leaders, and religious leaders. And above all, the citizens. No change will be possible without a coincidence between the legislative framework envisaged by population policies (both public and private) and free individual choices.

As we have seen, neither an increase in fertility rates, nor an extraordinary economic recovery, nor exceptional conditions of migratory attractiveness seem able to prevent the reduction in the number of residents. The realization of the most optimistic scenario, based on the combination of the most positive trends in birth rates and migrations, is unlikely. We must assume population decline as natural. And in doing so, we must mitigate the less desirable effects of this fact and sustainably manage the new reality being constructed. Planning in advance is the great challenge and opportunity. Demography is not only destiny, contrary to what Comte said. Political decisions, innovation, and changes in collective behaviours are the drivers of change in the Portugal of the future, which depends on the ability of Portuguese society to mitigate, articulate, and integrate certainties and uncertainties. That is, to implement concerted policies that promote well-being, economic, and social equity. Figure 7 suggests some examples of actions.

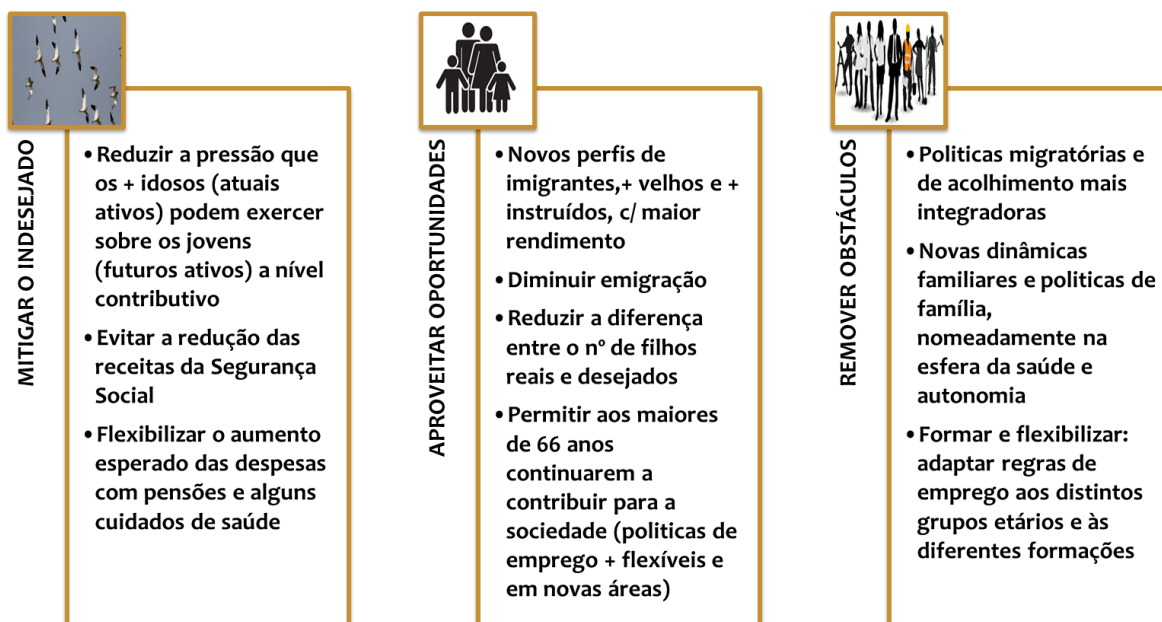


Figure 7 - Portugal. Mitigating the Undesirable, Seizing Opportunities and Removing Obstacles

Source: RODRIGUES, 2021b

Is demography an indispensable factor to ensure economic dynamism, or is it the other way around? The more conventional view considers that demographic dynamics condition

economic development and influence levels of social well-being, making it a priority to combat population decline and aging structures. The quickest way to try to achieve this is to import foreign populations to ensure more residents, more active population (and contributors), some rejuvenation of the age structure, and indirectly increase births. The second hypothesis favours adopting family-friendly policies, with integrated responses that improve daily living conditions (nursery-school-work schedules, support for caring for elderly family members, parents, and grandparents), promote the reconciliation of family and professional life, and stimulate the immigration of people of working age based on family reunification. The third approach involves the articulation between employment and education and adjusting the labour market. It includes recovering unemployed and NEET youth by investing in areas that equip young people with less traditional skills and developing on-the-job learning programs that facilitate the transition to active life. It also includes promoting active employment policies, such as self-employment and entrepreneurship, training plans adjusted to labour market needs, and individual career evolution and progression, promoting inter-profession and career transitions and greater contractual flexibility. Creating a second active life for the new elderly completes the range of suggestions.

But we can also consider the economy as a factor that enhances population dynamism and assume decline as the natural course for Portuguese society. In this case, the aim is to ensure economic development and well-being, regardless of population dynamics, which can be achieved through fertility, migration, or simply changing economic logic. Several authors argue that there is a positive correlation between fertility and development, so Portugal, like what happened in Northern Europe, could see fertility levels rise as it progresses in human development and gender equality. On the other hand, assuming that increased migration inflows could solve the issue of population decline or aging is impossible, both in terms of numbers and the social tension it would cause. The solution lies in reversing the logic and understanding that changes in the age structure do not negatively influence economic growth: 1) longevity and GDP per capita are positively correlated; 2) the future reduction in the labour force does not mean that the existing one is less productive (on the contrary, it can create pressure to increase wages, income, and consumption); 3) it is possible to avoid reducing the active population by introducing groups that were previously excluded into the labour market (unemployed youth, older people who want to work, increased female participation); 4) longevity, well-being, and consumption are positively correlated. However, the future should not be mapped out solely based on accounting balances. Each individual adapts their behaviours in search of well-being throughout their life cycle. Knowing that they will live longer and with better health, they may choose to work longer or retire earlier, and if pensions do not ensure the desired well-being, they will start saving earlier to guarantee the well-being they want in retirement. Thus, the supposed dependency at older ages may not be entirely real. Although in European societies the main state transfers are to the older group, due to welfare systems, some studies show that they make substantial transfers to younger generations. There is no single relationship between economy and demography, but if Portugal could establish itself in unique and strategic economic sectors (senior, thermal, and

health tourism), it could become a country where both native and foreign seniors (the age group that will increase the most) want to live. The country of Scenario 4.

2.2. BUSINESS INTELLIGENCE

Business Intelligence has been defined from an answer to a question that demonstrates its multifarious nature and various applications in modern entities. In the mid-20th century, Luhn, H. P. (1958) pioneered concepts integral to BI systems, advocating for the systematic processing of data to enhance decision-making. His vision of “intelligence amplification” laid the groundwork for modern BI, which blends machine-driven analytics with human expertise, empowering organizations to extract actionable insights from complex datasets.

Building upon Luhn's principles, BI evolved alongside the development of decision support systems (DSS) throughout the latter half of the 20th century (Cebotorean, E. 2007). As organizations sought more effective ways to leverage data for decision-making, the concept of BI began to crystallize. Howard Dresner, a seminal figure in this evolution, provided a pivotal definition in 1989, characterizing BI as an umbrella-concept with many techniques hanging underneath it (van Ufford, D. Q. 2002).

BI is frequently referred to as an umbrella term that brings together all the data disciplines of an organization, encapsulating tools, methodologies, and processes aimed at extracting actionable insights from data to inform strategic decision making (Shariat, M. & Hightower, R. 2007).

Since the early 21st century and continuing to the present day, BI has increasingly gained prominence in the corporate world. Due to the exponential growth of data, Traditional IT systems are becoming inefficient dealing with more complex information analysis disciplines such as Knowledge Management (KM) and Data Mining (DM) (Hawcking, P. & Sellitto, C. 2010).

It, therefore, indicates that due to the changing landscape of technology, BI strategies should be changed so that these organizations remain competitive in the market. This evolution includes improvements in BI tools and techniques or the way these advancements are aligned with the changing needs and expectations of users (Howson, C. 2013). The key to success lies in the organization's innate capacity to leverage emerging capabilities effectively (Schulze, J. H. 2020). By fostering a culture of innovation, investing in talent development, and staying attuned to industry trends, businesses can harness the full potential of BI to drive strategic decision-making, foster innovation, and achieve sustainable growth in a dynamic marketplace.

2.2.1 BUSINESS INTELLIGENCE ARCHITECTURE

Having a BI architecture is a critical factor in maximizing the potential of data usage, avoiding inconsistencies, and enabling the ability to share information among components. It ensures the ability to meet business requirements and achieve good business performance (Ong I. L. et al 2011). To achieve the best possible results, it is essential to thoroughly identify the layers of the architecture. These components include the Data Source, Extract-Transform-Load (ETL), Data Warehouse, Metadata and End User.

Data Sources are very crucial for gathering and storing information. They serve as the foundation from which organizations extract data for analysis, reporting and decision-making. Understanding where to find the required data is crucial for addressing specific business questions and requirements, leading to considerable time savings and faster information delivery (Ong I. L. et al 2011).

Extract-Transform-Load (ETL) is the process responsible for gathering data from multiple and diverse sources, transforming it through various operations such as cleansing, normalization, filtering, or validation, and loading it into a Data Warehouse (Vassiliadis, P. et al 2002).

According to the “father of data warehousing”, Bill Inmon, a data warehouse is a “subject-oriented, integrated, time-variant, and non-volatile collection of data that supports management’s decision making process”.

Metadata is considered an integral part of business information resources (BIR), embedded within compound and multiplex information classes. It encompasses both business metadata and technical metadata, which are valuable assets for business users and analysts seeking innovative ways to utilize data. Integrating metadata into the BIR simplifies workflows and enhances collaboration between business and IT stakeholders (Devlin, B. 2003).

According to Ralph Kimball, the end-user is the ultimate beneficiary of Business Intelligence systems, relying on intuitive interfaces and actionable insights to drive decision-making processes effectively.

2.2.2 MULTIDIMENSIONAL MODEL

The multidimensional model has emerged as a cornerstone in the realm of DA and BI. Central to this model is the concept of organizing data into a multidimensional structure, which allows complex querying and analysis. This model is instrumental in enabling users to perform complex analyses by structuring data into dimensions and measures, facilitating a comprehensive view of the information spread over the dataset.

Enhanced query performance is one of the primary advantages of the multidimensional model. By structuring data into predefined dimensions and hierarchies, the model allows for faster query performance compared to traditional relational databases. (Kimball, R. & Ross,

M. 2010) emphasize the performance benefits, noting that “the multidimensional model significantly reduces query time, providing near-instantaneous results for complex analytical queries”.

Another significant advantage is the intuitive nature and performance of data exploration within the multidimensional model. Users can navigate data intuitively, drilling down or rolling up through dimensions and do complex calculations (Thomsen, E. 2002). It drives the user to have a further knowledge of the data set and could be a key factor to develop or identify patterns in data for current and future analysis (Golfarelli, M. & Rizii, S. 2010).

Moreover, the multidimensional model ensures data integrity and consistency by defining data hierarchies and relationships explicitly. (Kimball, R. & Ross, M. 2010) argues that “structured hierarchies and relationships in the multidimensional model enforce data consistency, providing a single source of truth”, which is essential for maintaining reliable analysis outcomes and ensuring that decisions are based on accurate and consistent data.

2.2.3 DATA VISUALIZATION

(Few, S. 2007) traces the rise of data visualization into the corporate world, showing its increasing acceptance and adoption. However, it is to be appreciated that Few does indicate that while there are clear benefits from visualization, there are considerable challenges and drawbacks in the area of business intelligence. Fast forward to today's data-driven paradigm, where organizations grapple with the deluge of information, grasping Few's sentiments about the complicated structure of the analysis of such a large amount of data. Effective visual representation is, as Sadiku et al. (2016) put it, an indispensable part of scientific inquiry and the very essence of decision-making, exhibiting an insight into the constantly evolving curse that Few pointed out even today against hurdles and leaps in data analytics.

In today's data-driven world, mere presentation is not enough. Contextualizing raw numbers and statistics allows for effective audience engagement. And here is where storytelling enters consideration in DV - providing interactivity, engagement, and context to enhance understanding. When informative visualizations are accompanied by storytelling via a context or narrative, they can more effectively communicate meaning and importance to a variety of audiences (Kosara, R. 2013).

Some narrative visualization discourses introduced by (Segel, E. & Heer, J. 2010) deal with the notions that put together interactive visual representation with storytelling techniques. Narrative visualizations permit the understanding of complex information, but they also facilitate further and deeper understanding of datasets, making it a game changer for identifying insights and guiding future analysis.

Moreover, (Munzner, T. 2014) provides a framework for understanding different visualization design principles, categorizing techniques based on data types, tasks and audience needs. For

numerical data, histograms, density plots, and boxplots visualize distributions effectively. Scatterplots show relationships between variables. Proportions are best represented with pie charts, side-by-side bars, or stacked bars. Line graphs display trends in temporal data, while maps visualize geospatial data, highlighting patterns across locations. These visualizations cater to different data types, enhancing clarity and insight in data analysis.

In conclusion, data visualization continues to evolve as a critical tool for extracting insights and communicating findings effectively in various domains. By incorporating principles of clarity, simplicity, and narrative, organizations can leverage visualizations to inform decisions, drive innovation, and inspire meaningful action.

3. PROOF OF CONCEPT

3.1. DATA FLOW

The project revolves around leveraging Excel files as the primary data source, supplemented by data imported from Instituto Nacional de Estatística (INE) and Pordata, to establish a comprehensive BI solution. These data will be loaded into Power BI, and all transformations will be performed in Power Query, including normalization, cleaning, and column formatting, to have the data in the ideal shape for analysis.

The culmination of the project involves the creation of a dashboard using Power BI (PBI), to find patterns in the data in a way to explain the current Portugal's situation, but also the creation of policies to combat the problems faced.



Figure 8 - Data Flow

3.2. DATA SOURCES

To achieve the desired outcome, data was collected from the Instituto Nacional de Estatística and Pordata portals. The combination of these two information sources is crucial, as they are the largest providers of demographic and economic data in Portugal. The following sources were selected for their quantity and quality of attributes to ensure a thorough analysis and the development of future policies.

Excel report extracted from INE, providing attributes such as:

- Year
- County
- Age Groups
- Gender
- Resident Population

Excel report extracted from Pordata, providing attributes such as:

- Year
- County
- Gender
- Immigrant Population

Excel report extracted from Pordata, providing attributes such as:

- Year
- County
- Work Sector
- Gender
- Employed Population

Excel report extracted from Pordata, providing attributes such as:

- Year
- County
- Gender
- Unemployment Population

Excel report extracted from Pordata, providing attributes such as:

- Year
- County
- Work Age Group
- Inactive Population

Excel report extracted from Pordata, providing attributes such as:

- Year
- County
- Natural Balance
- Migration Balance

Excel report extracted from Pordata, providing attributes such as:

- Year
- County
- Created companies
- Dissolved companies
- Imports
- Exports

3.3. DATA INTEGRATION

The successful learning efforts through data integration build the underpinning of any ambitious project. Preparation guarantees high-quality outcomes, which is relevant to this task is the ETL used for transforming raw data into some useful means. This process should be performed with utmost care because it is of the utmost importance to a system that intends to use a single structured database.

This involved the extraction of the raw data from two sources made from two .xlsx format files. Power Query gives an easy and comprehensive view of the imported files and permits joining them so that a unified perspective of the extracted data can be obtained. This look at the whole issue would be key to the successful continuance into the transformation step.

Once extracted, the raw data underwent the transformation phase. In Power Query, various treatments were applied to ensure the data was ready to be loaded. The operations included the removal of duplicate values, normalization, elimination of irrelevant data for the project, and the application of filters.

The final stage of the ETL process, the loading phase, occurs when the transformed data is inserted into the PBI data model, where it is used for analysis and visualizations. Thanks to the transformations applied in Power Query, the cleaned and structured data was ready to be explored, ensuring an optimized system and good performance.

3.4. DIMENSIONAL MODEL AND METRICS

Following the ETL process, a relational dimensional model with 7 fact tables and 6 dimension tables was built along the constellation schema. The schema allows various fact tables to connect to multiple dimension tables, resulting in an integrated and comprehensive view of data.

The fact tables offer the most important numeric data to be set by analysis, while the dimension tables hold a wealth of contextual attributes relevant to each of those analyses. Furthermore, this model allows one fact table to interact with several dimensions that allow a richness and insight into the dashboard.

Building this model involved clearly the relationships between facts and dimensions, ensuring all associations were accurate and the data integrity was maintained. This model allows for flexible and efficient data exploration, providing a solid foundation for advanced analyses and informed decision-making within PBI.

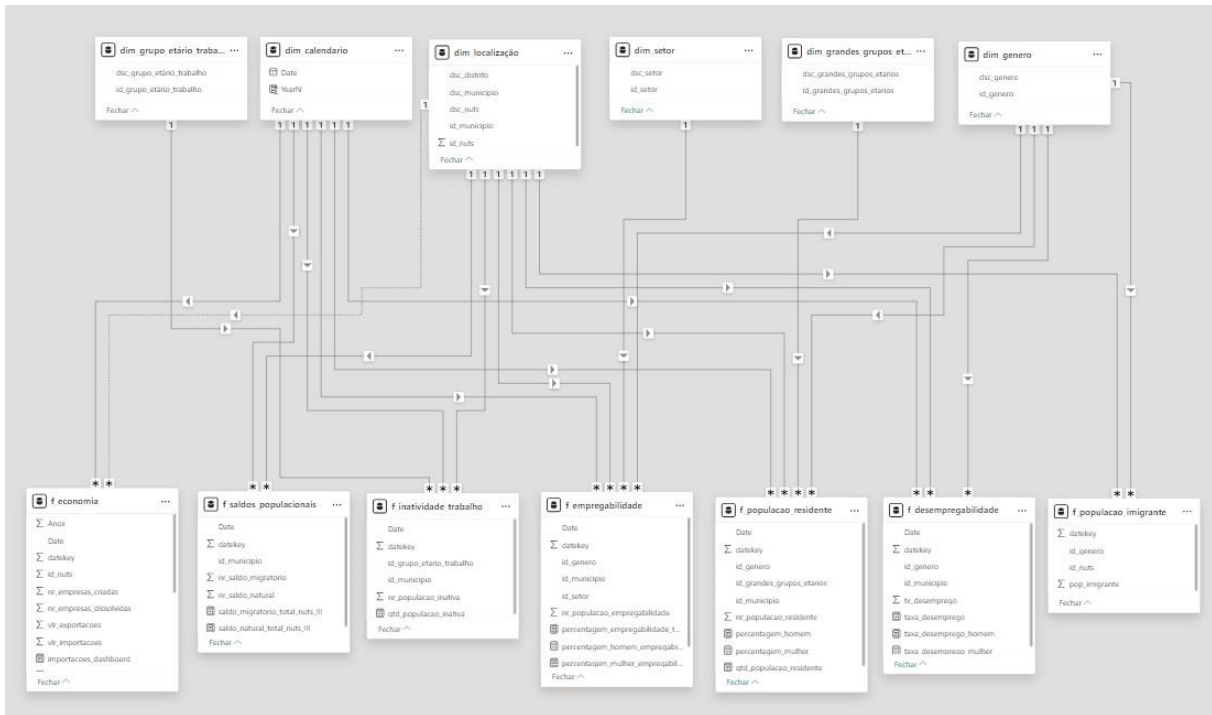


Figure 9 - Dimensional Model

After the dimensional model was established, measures were created to support data analysis. Using DAX (Data Analysis Expressions), various measures were developed to perform calculations and generate essential metrics. These measures provide the analytical foundation necessary for extracting insights from data.

The following measures were created:

- **População Residente**

Definition: A group of individuals who, regardless of being present or absent at a specific lodging during observation, have lived in their usual place of residence for at least 12 consecutive months before the observation, or who arrived at their usual residence within the 12 months prior to the observation with the intention of staying for at least one year.

DAX Expression: `SUM(f_populacao_residente[nr_populacao_residente])`

- **% População Residente Masculino**

Definition: Ratio of the male resident population in the total resident population.

DAX Expression: `CALCULATE([Populacao Residente], dim_genero[dsc_genero] = "masculino")/[Populacao Residente]`

- **% População Residente Feminina**

Definition: Ratio of the female resident population in the total resident population.

DAX Expression: `CALCULATE([Populacao Residente], dim_genero[dsc_genero] = "feminino")`
`/[Populacao Residente]`

- **População Imigrante**

Definition: Group of individuals of non-Portuguese nationality with a residence permit or card, in compliance with current immigration legislation. Does not include foreigners with regular status under the granting of stay permits, short-term visas, study, work, or temporary stay visas, as well as foreigners with irregular status.

DAX Expression: `SUM(f_populacao_imigrante[pop_imigrante])`

- **% População Imigrante Masculino**

Definition: Ratio of the male immigrant population in the total immigrant population.

DAX Expression: `CALCULATE([Populacao Imigrante], dim_genero[dsc_genero] = "masculino")`
`/[Populacao Imigrante]`

- **% População Imigrante Feminina**

Definition: Ratio of the female immigrant population in the total immigrant population.

DAX Expression: `CALCULATE([Populacao Imigrante], dim_genero[dsc_genero] = "feminino")`
`/[Populacao Imigrante]`

- **Saldo Migratório**

Definition: The difference between immigration (entry) and emigration (exit) during the year.

DAX Expression: `SUM(f_saldos_populacionais[nr_saldo_migratorio])`

- **Saldo Natural**

Definition: The difference between live births and deaths during the year.

DAX Expression: `SUM(f_saldos_populacionais[nr_saldo_natural])`

- **População Inativa Trabalho**

Definition: Population that, regardless of age, during the reference period could not be considered economically active, meaning they were neither employed nor unemployed.

DAX Expression: `SUM(f_inatividade_trabalho[nr_populacao_inativa])`

- **População Empregada**

Definition: An individual aged between 16 and 89 who, during the reference period, was in one of the following situations:

a) had worked for at least one hour, receiving payment or aiming for a family benefit in cash or kind.

b) had a job but was not at work while maintaining a formal connection to their job.

c) owned a business but was temporarily not working for a specific reason.

d) was in a pre-retirement situation but was working during the reference period.

DAX Expression: `SUM(f_empregabilidade[nr_populacao_empregabilidade])`

- **% População Empregada Masculino**

Definition: Ratio of the male employed population divided by the total employed population.

DAX Expression: `CALCULATE([Populacao Empregada], dim_genero[dsc_genero] = "masculino") / [Populacao Empregada]`

- **% População Empregada Feminina**

Definition: Ratio of the female employed population in the total employed population.

DAX Expression: `CALCULATE([Populacao Empregada], dim_genero[dsc_genero] = "feminino") / [Populacao Empregada]`

- **% População Empregada por População Residente**

Definition: Ratio of the employed population in the total resident population.

DAX Expression: `DIVIDE([Populacao Empregada], [Populacao Residente])`

- **População Desempregada**

Definition: Ratio of the employed population in the total resident population.

DAX Expression: `SUM(f_desempregabilidade[nr_populacao_desempregabilidade])`

- **% População Desempregada no total de População Residente**

Definition: Ratio of the employed population in the total resident population.

DAX Expression: `DIVIDE([Populacao Desempregada],[Populacao Residente])`

- **% População Desempregada Masculino**

Definition: Ratio of the male unemployed population in the total unemployed population.

DAX Expression: `CALCULATE([Populacao Desempregada], dim_genero[dsc_genero] = "masculino") / [Populacao Desempregada]`

- **% População Desempregada Feminina**

Definition: Ratio of the female unemployed population in the total unemployed population.

DAX Expression: `CALCULATE([Populacao Desempregada], dim_genero[dsc_genero] = "feminino") / [Populacao Desempregada]`

- **Created Companies**

Definition: Quantity of created companies.

DAX Expression: `SUM(f_economia[nr_empresas_criadas])`

- **Var % Created Companies**

Definition: Year-over-year growth in the number of created companies.

DAX Expression: `VAR ano_atual = SUM(f_economia[nr_empresas_criadas])`

`VAR ano_anterior = CALCULATE(SUM(f_economia[nr_empresas_criadas]),
DATEADD(dim_calendario[Date],-1,YEAR))`

`RETURN DIVIDE(ano_atual, ano_anterior)-1`

- **Dissolved Companies**

Definition: Quantity of dissolved companies.

DAX Expression: `SUM(f_economia[nr_empresas_dissolvidas])`

- **Var % Dissolved Companies**

Definition: Year-over-year growth in the number of dissolved companies.

DAX Expression: `VAR ano_atual = SUM(f_economia[nr_empresas_dissolvidas])`

`VAR ano_anterior = CALCULATE(SUM(f_economia[nr_empresas_dissolvidas]),
DATEADD(dim_calendario[Date],-1,YEAR))`

`RETURN DIVIDE(ano_atual, ano_anterior)-1`

- **Imports**

Definition: The import of goods and services consists of transactions of goods and services (purchases, direct exchanges, and offerings) from non-residents to residents. The import of goods occurs when there is a transfer of economic ownership of goods between residents and non-residents (whether or not corresponding physical movements of goods across borders take place). The import of services includes all services provided by non-residents to residents.

DAX Expression: `SUM(f_economia[vlr_importacoes])`

- **Var % Imports**

Definition: Year-over-year growth in the number of imports.

DAX Expression: `VAR ano_atual = SUM(f_economia[vlr_importacoes])`

`VAR ano_anterior = CALCULATE(SUM(f_economia[vlr_importacoes]),
DATEADD(dim_calendario[Date],-1,YEAR))`

`RETURN DIVIDE(ano_atual, ano_anterior)-1`

- **Exports**

Definition: The export of goods and services consists of transactions of goods and services (sales, direct exchanges, and offerings) from residents to non-residents. The export of goods occurs when there is a transfer of economic ownership of goods between residents and non-residents (whether or not the corresponding physical movements of goods across borders take place). The export of services includes all services provided by residents to non-residents.

DAX Expression: `SUM(f_economia[vlr_exportacoes])`

- **Var % Exports**

Definition: Year-over-year growth in the number of exports.

DAX Expression: `VAR ano_atual = SUM(f_economia[vlr_exportacoes])`

`VAR ano_anterior = CALCULATE(SUM(f_economia[vlr_exportacoes]),
DATEADD(dim_calendario[Date],-1,YEAR))`

`RETURN DIVIDE(ano_atual, ano_anterior)-1`

- **Balance**

Definition: The difference between exports and imports.

DAX Expression: `[Exports] - [Imports]`

- **Var % Balance**

Definition: Year-over-year growth in the difference between exports and imports.

DAX Expression: **VAR** ano_atual = [Balance]

VAR ano_anterior = **CALCULATE**([Imports], **DATEADD**(dim_calendario[Date],-1,YEAR))

RETURN DIVIDE(ano_atual, ano_anterior)-1

3.5. DASHBOARD

The dashboard is a broadly framed tool of nine pages-from which you will find-depth information in key areas as follows: resident population, unemployment rates, inactivity rates, employment data, and both demographic and economic balances. Each page is carefully created to depict essential data points and trends, providing users a complete overview of demographic dynamics in and their consequences in Portugal. The dashboard, with a friendly and user-friendly interface and interactive buttons for ease of navigation, allows users to move around the pages with ease from one topic to another, thus enabling them to navigate and interrogate each topic in detail. This, in turn, presents users with a perfect opportunity to draw conclusions from the wealth of data.



Figure 10 - Cover Page

- **Resident Population**

The first page presents a glimpse of the resident population of Portugal, with the data coming from census years of 1960, 1981, 1991, 2001, 2011, and 2021. Five buttons on the left allow users to traverse these pages. Since some themes might span several pages, a kind of continuity, provided with navigation, commences to redirect from one page to the first page of the next theme.

This page offers three types of filtering: years, gender, and major age groups (0-14, 15-64, and 65 +). These filters allow users to customize their view of the data to their interests and provide easier means of examining patterns across different populations.



Figure 11 - Resident Population

Starting at the top left, the area chart shows the increasing resident population. This illustration helps to see the general population trend within the resident population. The page is also lined with a ring chart that allows the validation of the resident population distribution by gender.

Resident population by gender and major age groups is shown in a grouped column chart in the centre of the page. The chart provides a very good picture of how the various populations are spread in the population in each of the two categories and helps to visualize what the age cohorts are and the distribution according to gender. In the bottom left, the data is represented in a matrix format, with NUTS III regions and counties cross tabulating the complete growth absolute indices by area. This matrix allows for regional comparisons of changes in the population, making for easy recognition of areas with higher or lower growth rates.

The heat map of the Portuguese territory sits to the right of the dashboard. The colouring on the map is according to the absolute value of population size, rendering a geographical vision of population density and distribution. Below the heat map on the right, a grouped bar chart shows the population by district, with a highlight of the five leading districts. It gives the viewer a quick overview of the biggest populated areas for any further analysis into the concentration of the population at the district level.

This typology works toward getting a wide-format, organized view of the data on resident populations in Portugal, helps users easily navigate through detailed demographic insights.

- **Immigrant Resident Population**

The second page offers insights into Portugal's immigrant population, using data from 2009 to 2023. The interface includes five side buttons for easy navigation between pages, with some themes spanning multiple pages, where navigation redirects to the first page of each theme for consistency.

This page provides filtering options by year and gender, allowing users to customize the data view to suit their interests. These filters make it easier to examine demographic patterns within the immigrant population, providing a detailed perspective on trends across various groups.

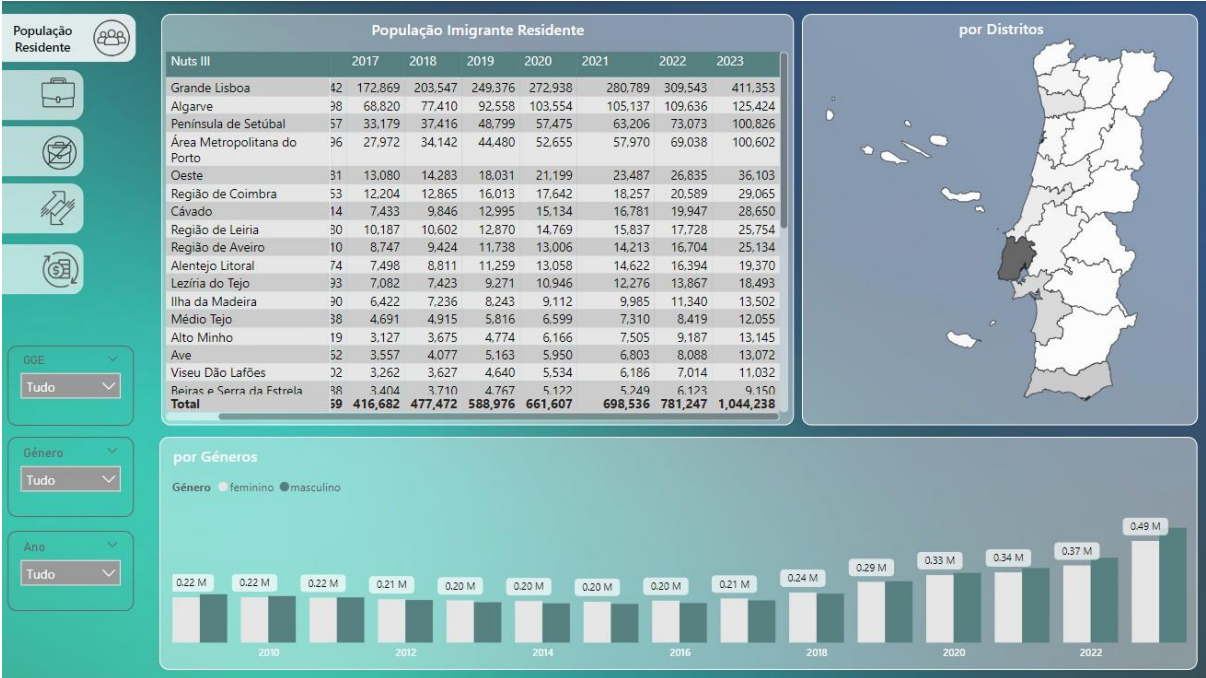


Figure 12 - Immigrant Population

The table at the top left shows the absolute values of the immigrant population residing in Portugal according to the NUTS III region for the various points in time. On the right-hand side,

the map is used to display a visualization of the absolute distribution of the immigrant population throughout Portuguese territory, allowing the very identification of a geographic perspective of immigration density.

At the bottom, a grouped column chart shows the immigrant population by gender for the extracted years, permitting the user to observe the trend of the gender distribution within the immigrant population in different periods.

- **Employed Population**

The third page provides insights into Portugal's employed population, with data extracted from census years 1960, 1981, 1991, 2001, 2011, and 2021. The interface includes five side buttons for navigation between pages. Some themes span multiple pages, so navigation is set to redirect to the first page of each theme for continuity. The page includes three filtering options: by year, gender, and major age groups (0-14, 15-64, and 65+).

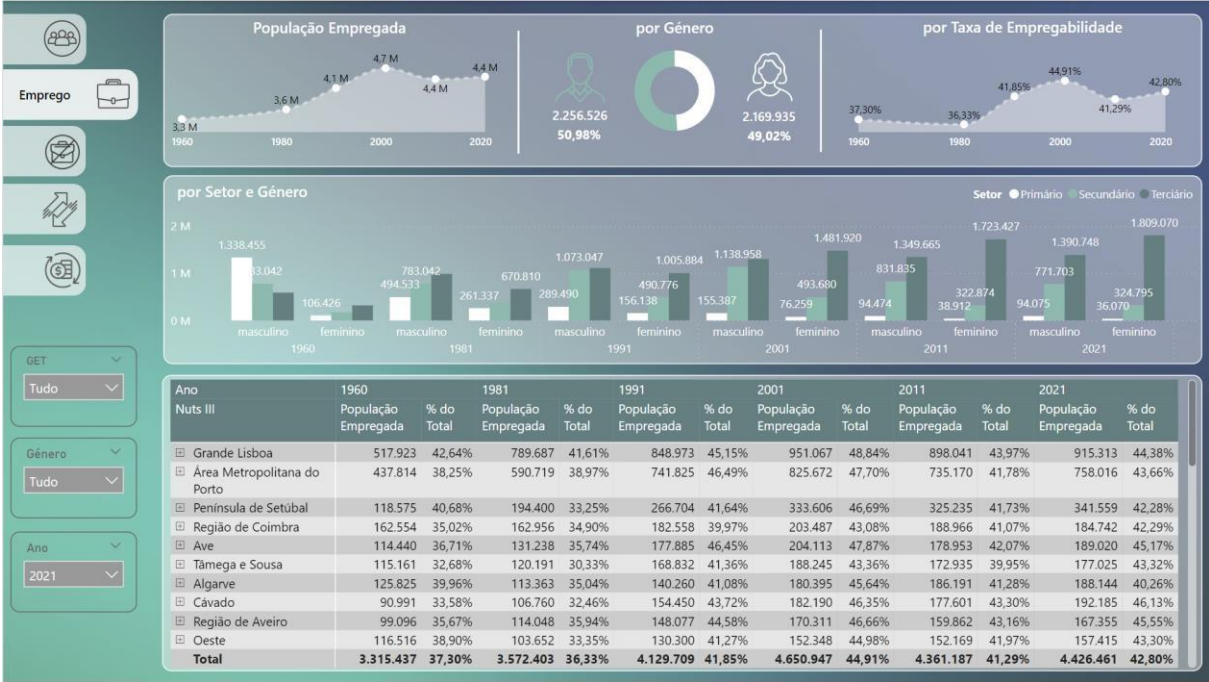


Figure 13 - Employed Population

This page focuses on employment data, providing a multi-dimensional view of the employed population and employment trends over time.

Top left: An area chart showing the evolution of the employed population over time—a way to tell how employment has grown or shrunk over time. In the centre-top area, a ring or donut chart with the breakdown of the employed population by gender, based on the selected year. In the top centre, it shows a ring or donut chart with the breakdown of the employed

population by gender, based on the selected year. On the top right is another area chart showing variation in employment rate over the years in the dataset. It shall give a clear view of the employment trend over time.

In the middle of the page, there is a grouped column chart showing the employed population by gender (male and female) and by sector of activity, or industry sector: primary, secondary, and tertiary sectors. With this chart, the user can realize how employment is segmented among genders and industries and the representation in each sector. At the bottom of the page, an absolute summary table is presented on the employed population, with percentages compared with the resident population. This data is organized by NUTS III areas and counties in a hierarchical structure; it also allows the study of employment relative to the total population at a regional level.

- **Unemployment and Inactivity**

The fourth page provides insights into Portugal's unemployment and inactive population, with data drawn from the census years 1960, 1981, 1991, 2001, 2011, and 2021. The interface includes five side buttons for navigation between pages. Some themes span multiple pages, so navigation is set to redirect to the first page of each theme for continuity.

This page offers three filtering options—by year, gender, and work age groups (15-24, 25-34, 35-44, 45-54, 55-64, and 65+). These filters enable users to refine the data view to focus on specific demographics, making it easier to examine patterns and trends in unemployment and inactivity across various population segments.



Figure 14 - Unemployment and Inactivity

On this page, the data is divided into sections for unemployment and inactivity indicators, each with visuals providing a detailed view of these metrics.

On the left side, we find key unemployment indicators. In the top-left corner, an area chart displays the unemployment rate as a percentage over time, helping to illustrate fluctuations in unemployment across the census years. In the center of the left side, another area chart breaks down the unemployment rate by gender, showing trends separately for male and female populations. At the bottom left, a grouped bar chart ranks NUTS III regions by their unemployment rate in descending order, allowing for quick identification of the regions with the highest rates.

On the right side of the page, the focus shifts to population inactivity in absolute values. In the top-right corner, an area chart illustrates the growth of the inactive population over the census years, providing a clear view of inactivity trends over time. In the middle right section, a grouped column chart distributes the inactive population across work age groups, showing the variation in inactivity across different age categories. Finally, at the bottom right, another chart highlights the NUTS III regions with the largest inactive populations, pinpointing the areas with the most significant levels of inactivity.

This layout allows for a comprehensive comparison of unemployment and inactivity metrics, both across demographic groups and by regional distribution, offering a nuanced view of these aspects within Portugal.

- **Population Balances – Natural**

The fifth page provides insights into Portugal's natural population balance, with data from 2009 to 2022. The interface includes five side buttons for navigating between pages, and since some themes span multiple pages, navigation directs users to the first page of each theme for continuity.

This page includes two filtering options: by year and NUTS III regions, allowing users to focus on specific demographics and regions. These filters make it easier to analyse patterns and trends in natural population balance, providing a clear view of changes over time across different segments and areas.



Figure 15 - Natural Population Balance

This page features a scatter plot displaying the natural population balance from 2009 to 2022 across the various NUTS III regions within Portuguese territory. The NUTS regions shown in purple follow a common pattern, highlighting similar trends in natural balance across most regions. However, two NUTS regions—Grande Lisboa and Área Metropolitana do Porto—stand out as outliers, falling outside the usual dispersion pattern.

- **Population Balances – Migratory**

The sixth page offers insights into Portugal's migratory population balance, using data from 2009 to 2022. The interface includes five side buttons for seamless navigation between pages, with themes spanning multiple pages redirected to the first page of each theme for consistency.

This page includes two filtering options: by year and by NUTS III region, allowing users to focus on specific time periods and geographical areas. These filters enable a more detailed analysis of patterns and trends in migratory population balance, providing a clear view of how migration dynamics have evolved over time across different regions.



Figure 16 - Migratory Population Balance

This page shows a scatter plot of the migratory population balance between 2009 and 2022 for all NUTS III regions in Portuguese territory. Most of the coloured NUTS are purple, which indicates that they all share a general behaviour, as similar trends in migratory balance are presented. On the other hand, four regions stand out from this pattern: Grande Lisboa, Área Metropolitana do Porto, Península de Setúbal, and Algarve. These peculiar trends in the movement of migration will be further analysed in the discussion of results.

- **Economy - Companies**

The seventh page provides insights into Portugal's created and dissolved companies, with data from 2009 to 2023. The interface includes five side buttons for navigating between pages, and since some themes span multiple pages, navigation directs users to the first page of each theme for continuity.

This page includes two filtering options: by year and by NUTS III region, enabling users to focus on specific time frames and geographic areas. These filters facilitate the analysis of patterns and trends in company creation and dissolution, offering a clear view of business dynamics over time and across various regions.

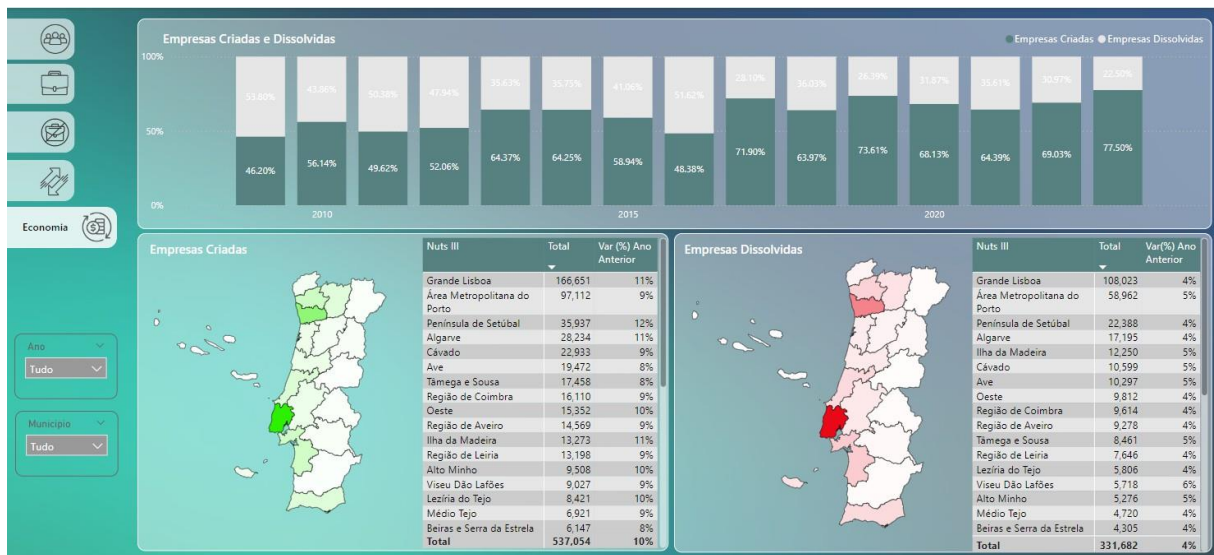


Figure 17 - Created and Dissolved Companies

The eighth page outlines the company creation and dissolution dynamics in Portugal.

Above, a grouped column chart can be seen in percentiles, which gives insight into the percentage of created versus dissolved companies with respect to the total number. This represents a clear ratio that balances these two types of indicators against each other.

On the bottom of the page, left-hand side, an absolute values map of newly created companies across regions can be seen. On the right-hand side, a table shows cumulative values created by NUTS III region, with year-over-year variation, as an expression of regional growth trends.

On the very right, another map shows the absolute values of dissolved companies. Next to this map, a table with the cumulative number of dissolved companies by NUTS III region and variation concerning the previous year is shown; the regional point of view of the business closures and its variation along time is thus presented.

- **Economy – Imports and Exports**

The ninth page provides insights into Portugal's import and export values in euros, with data spanning from 2009 to 2023. The interface includes five side buttons for navigating between pages, and since some themes extend across multiple pages, navigation directs users to the first page of each theme for continuity.

This page includes two filtering options: by year and by NUTS III region, allowing users to focus on specific time periods and geographic areas. These filters facilitate the analysis of patterns

and trends in import and export activities, offering a comprehensive view of trade dynamics over time and across different regions.

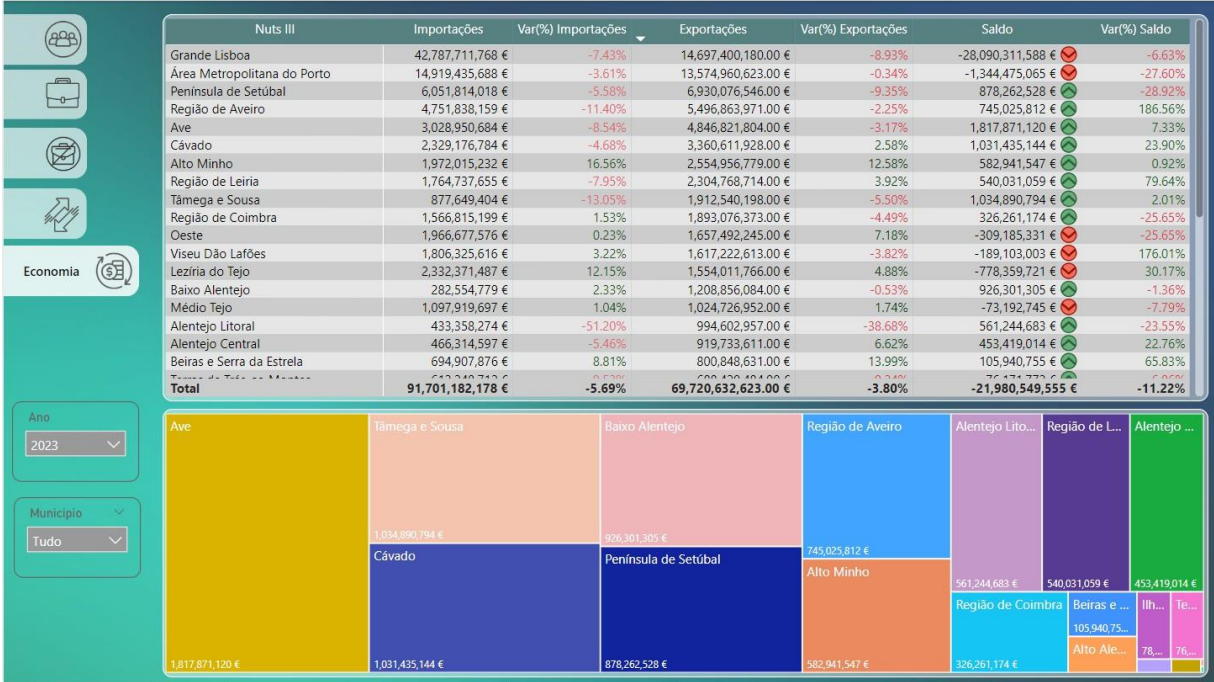


Figure 18 - Imports and Exports

At the top of the page, there is a table containing information on imports, exports, and their annual variations, along with the balance between the two. This table provides a quick overview of trade flows and highlights the net trade balance for each year.

A tree map chart below shows the top NUTS III regions that are contributing the most to a positive trade balance. This visualization outlines the most impactful regions contributing to the net export of Portugal, considering how much simpler it is to get the key contributors of the positive trade balance.

4. RESULTS AND DISCUSSION

In this chapter, an analysis of the constructed solution will be conducted to address the project's key questions mentioned in section 1.2 of this study. Additionally, we are entering phase 5 of the DSRM model, outlined in section 1.4, where the goal is: Once the tool is completed, it will be evaluated to determine whether it successfully addresses all the goals. This step will involve analysing whether the dashboards meet the requirements and identifying if any refinements or redesigns are necessary for optimal performance.

Regarding the first page of the dashboard, which focuses on the topic of the resident population through the timeline of census data, it is evident that the last three decades have seen stagnation in the total number of inhabitants. In 2001, the resident population was 10.4 million; in 2011, it rose slightly to 10.6 million; and in 2021, it decreased to 10.3 million. Furthermore, there is significant dispersion within the age groups: in 2021, the 0-14 age group accounted for 1.3 million inhabitants, the 15-64 age group (considered the active class) had 6.6 million, and those aged 65 and over (the elderly) represented 2.4 million. This scenario could indicate a potential difficulty in ensuring generational replacement in Portugal in the coming years. Moreover, it is possible to observe a significant concentration of the population in coastal regions, particularly in Grande Lisboa and Área Metropolitana do Porto.

Regarding the resident immigrant population, based on data extracted from the years 2009 to 2023, it is evident that until 2018, the immigrant population remained stable. However, from that year onward, there has been a significant annual increase, which was most notable in 2023. Similar to the total resident population, Grande Lisboa area continues to be the primary destination for immigrants (411.000 immigrants in 2023). In a secondary tier of preference are Peninsula de Setúbal, Algarve, and Área Metropolitana do Porto, which together accounted for approximately 325.000 immigrants across these three NUTS regions in 2023. It is also notable that until 2019, immigration was balanced between genders, with a slight tendency toward females. However, since then, there has been a shift, with immigration now consisting of more men than women.

On the employed population page the total employed population is examined, along with the employment rate as a percentage of total resident population. The trends in the data indicate that the employed population did rise consistently from 1960 to 2001 and mirrored the rise of resident population discussed earlier. Between 2001 and 2021, it stayed stable.

When this measure is analysed by work sector (primary, secondary, and tertiary), a shift over time becomes apparent. In 1960, primary sector work was predominant, but over time, there was a transition toward tertiary sector work. It is also observed that within the labour sectors, there has been a greater allocation of women in the tertiary sector in more recent years. Additionally, for men, the same pattern is evident, although there is also a significant allocation in the secondary sector.

In addition, at the level of NUTS III regions level, it was possible to find regions with a higher absolute value of employed population that did not correspond necessarily a higher employment rate: examples are Grande Lisboa, Área Metropolitana do Porto, and Península de Setúbal. On the other hand, there were regions where a higher number of employed individuals also corresponded to an increase in the employment rate, such as Ave, Tâmega e Sousa, and Região de Aveiro.

The data also allow us to identify a third profile, where population growth occurred but the employment rate remained constant, as seen in the cases of Coimbra, Algarve, and Oeste.

On the page dedicated to unemployment and inactivity, metrics such as the percentage of unemployed individuals and the size of the inactive population were analysed. Regarding the unemployment rate, during the census period examined, it was observed that in most years, it fluctuated between 7% and 9.5%. In 1960, it recorded very low values of around 1.6% of the total population, while in 2010, it reached a peak of 12.55%, possibly due to the economic crisis experienced in Portugal in 2008. It is also evident that the unemployment rate has consistently been higher among women compared to men. However, since 2010, these values have become increasingly closer, showing that the current difference between the unemployment rates for both genders is almost negligible. Additionally, it is noted that the archipelagos are the regions with the highest unemployment rates, followed by the Algarve and Península de Setúbal.

As for the number of inactive individuals, a consistent growth pattern is evident over the years. It is also possible to confirm that the NUTS III regions with the largest populations are those that also have the highest number of inactive individuals.

Next, on the page dedicated to natural population balance, the analysis was conducted based on data from 2009 to 2022. It is evident that all NUTS III regions are experiencing a year-on-year decline, meaning there are increasingly more deaths and fewer births. Most regions follow the same downward trend; however, one region presents more significant results, which will be analysed in detail.

The region of Grande Lisboa remained the best-performing region in terms of natural balance until 2019, maintaining a positive balance of over 2,000 people per year. After 2019, the population experienced a complete shift, presenting negative figures in the range of -4,000 people per year.

On the page dedicated to the migratory balance, the analysis focuses on the number of immigrations compared to emigrations. The results align with those obtained on the immigrant population page, highlighting regions such as the Algarve, Península de Setúbal, and Área Metropolitana do Porto.

In contrast to the natural balance, the migratory balance follows an upward trajectory. Between 2010 and 2014, emigrations were predominant. However, from 2014 to 2022, there

has been growth, with significantly more immigration than emigration in the majority of NUTS III regions.

On the economy page “Created and Dissolved Companies” the analysis delves into the yearly trends of company creation and dissolution, along with the ratio between these metrics. The data reveal a clear trend: over the years, the number of companies created has consistently exceeded the number of those dissolved. Notable exceptions occurred in 2009, 2011, and 2016, when the number of dissolved companies briefly surpassed new creations, potentially reflecting broader economic instability during those periods, such as the aftermath of the global financial crisis. A deeper look shows that company dynamics are most prominent in coastal regions, with areas like Grande Lisboa and Área Metropolitana do Porto leading in both metrics. This pattern highlights the economic vitality and concentration of businesses in these regions, driven by higher population densities, better infrastructure, and increased access to markets.

On the page of Economy, the focus is on the value of imports and exports of each region: "Imports and Exports". As can be perceived, Grande Lisboa and Área Metropolitana do Porto have the highest values of imports and exports. However, this may be a problem in the future since these regions, with big populations, tend to keep a high dependency from other regions.

Inland regions like Ave, Cávado, and Região de Aveiro have much more favourable trade balances. These regions present import values in a stable regime but perform well in export output, highlighting their production capability and competitiveness in the external market. This disparity underlines the different economic dynamics between coastal and inland regions, but the latter might be more viable in their model, given their capacity for higher export surpluses. It really gives a cue on the need for balanced regional development to cut dependence and enhance resilience in the national economy.

Following these analyses, there is a growing trend of mobility toward the two major metropolitan areas of Lisbon and Porto, driven by factors like economic opportunities, infrastructure, and access to services. However, this concentration in coastal regions raises significant concerns about the depopulation of interior areas, which remain underutilized despite their potential to contribute significantly to the country's overall development.

Therefore, to address these challenges and promote a balanced national development, the following issues could be advanced:

- Business Incentives relocating and investing in interior regions

(1) Tax breaks and financial incentives for businesses that set up operations in rural and interior regions can encourage job creation and investment. For example, offering reduced corporate tax rates, grants for new businesses, and subsidies for research and development in these areas could stimulate local economies.

(2) Setting up innovation hubs in these regions would attract tech startups and businesses in sectors such as agriculture, renewable energy, and manufacturing. This will help in diversifying the economy and reduce dependence on other economies.

- Infrastructure and Connectivity Improvement

(1) Transport networks (roads, railways and airports) need to be improved, so that the hinterland is effectively connected to cities such as Lisboa and Porto. High-speed internet and modern digital infrastructures should be prioritized to support remote work, education, and access to services, making this more attractive for people and businesses to settle in these areas.

(2) Developing a more sustainable urban development in smaller towns and cities would decongest the pressure of large urban centres while offering a better quality of life with available, affordable housing, which in turn will spur local economic growth.

- Education and Talent Retention

(1) Establishing regional university campuses and technical training centres could ensure that students from rural areas have access to higher education without having to move to large cities. Additionally, offering scholarships or loans to students from these regions could increase the number of young people who choose to remain or return after completing their studies.

- Promotion of Telecommuting and Remote Work

(1) As digitalization and remote working develop, tax incentives can be given to those companies that allow working remotely, making it possible for people to live in inland regions and work for companies with headquarters in Lisbon, Porto, or even abroad. That would take a lot of pressure off cities and balance the economic activity across the country.

- Population Retention and Migration Policies

(1) Immigration policies that attract skilled workers from abroad to interior regions might counteract this population decline. This could include specific visa programs or residency options for individuals who are willing to live and work in less populated areas of Portugal.

(2) Youth retention programs are crucial, focusing on ensuring that younger generations see a future in their home regions. Creating job opportunities in sectors like digital marketing, technology, and green energy could provide pathways for young people to stay.

By implementing these strategies, Portugal could address the challenges of urban concentration, better balance its development across the country, and take advantage of the untapped potential in its interior regions. A more balanced approach would also create jobs,

quality of life improvement for both urban and rural people and sustain economic growth. These measures would mean a stronger, more resilient economy for Portugal in the long run.

5. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORKS

These limitations, during the elaboration of this study and the proof of concept, have been identified and involve elements that make it difficult to properly collect data and analyse it. Technical factors, data accessibility, and granularity were important deterrents to analysing some areas of interest within this project in a more complete and specific way. Regarding such gaps, the proposition of recommendations aimed at increasing the accessibility, quality, and coherence of data were advanced for new projects.

Table 1 - Limitations and Recommendations

Limitation	Recommendation
Data integration from INE was complicated, and in some cases, it was hard to access certain datasets. Only with great efforts of extra work and adaptation was it possible to complete.	Automate the data integration process by combining data coming from INE with other complementary data sources. Also, maintain permanent contact with INE and suggest changes for easy access to the most important sets of data.
Key project indicators, such as the sustainability index, were only available starting in 2023, limiting historical analysis.	Develop models to estimate historical data based on trends from related indicators. Alternatively, prioritize supplementary data sources to enrich historical context.
Variability in data granularity between indicators restricted the ability to perform detailed, cross-referenced analysis across all variables.	Standardize data granularity by aggregating finer-grained data to match broader categories or disaggregating where possible through estimation techniques. Alternatively, prioritize indicators with consistent granularity to enable reliable cross-comparisons while acknowledging limitations.

To enhance the study, an analysis could be conducted comparing NUTS III regions with countries in Europe to better understand their growth levels. By applying clustering techniques, it would be possible to group regions and countries based on economic and demographic similarities. This approach would allow for a more refined segmentation, helping to isolate and analyse regional and national characteristics with greater precision and relevance.

6. CONCLUSIONS

Portuguese society needs to face the ongoing changes, rethink age groups, and particularly reconsider what is considered early retirement, late retirement, and old age, to create a comprehensive age policy that articulates the criteria for analysing this new reality. As always, the knowledge permitted by population information is an indispensable backdrop. Demography is not just a destiny...we can and should use the information contained in statistical series as a useful tool to understand the current reality, in this case, the economic strengths and weaknesses that arise from it, and try to understand how the future might unfold and how to transform potential risks and threats into opportunities.

Regardless of what happens in terms of volume, aging, geographical distribution, and collective behaviours towards life and death, what we want is the guarantee that our society will continue to strive for improving Human Development indicators in the areas that matter most to enhance the quality of life and well-being of all residents. The consequences of what is to come do not necessarily have to be negative, but they require sustained planning and new choices. We have chosen three priority intervention areas to manage the change.

The first is related to migrations. Although Portugal's welcoming policies rank among the best, entry volumes remain moderate because of a lack of job opportunities, and the majority profile of immigrants seeking Portugal is that of low-skilled economic immigrants. The Strategic Plan for Migrations (2015-2020) defines axes and measures to change this situation and emphasizes the need to attract more skilled immigrants, creating conditions that favour labour market stability, promote employment (training), and revalue activity sectors (science, education, tourism, and health), which can make Portugal a preferred country of residence for high-income retired citizens (Government of Portugal, 2015).

The second relates to the much-discussed Birthrate and Family policies. The solution to alter the negative birthrate trend requires the implementation of integrated solutions that align individual aspirations with family realization. It is not strictly a financial issue, but rather a lack of future expectations and distrust in institutions. It is about removing barriers to family quality time: implementing an integrated birthrate policy involving all stakeholders for all citizens; valuing the family as the basic unit of society; enacting measures that, rather than creating benefits, reduce obstacles for those who want more children, and taking a strategic and forward-looking attitude, because behavioural changes in this area occur over long periods.

Finally, we must intervene in Employment and Education policies and enact measures targeted at specific age groups. For young people, this means facilitating their entry into the labour market (developing training programs that bridge the gap between the education system and employment, subsidizing their hiring, and granting tax benefits that encourage active job seeking and discourage dependency on subsidies); for older people, it could involve preventing early retirement (encouraging more workers to work longer, creating new forms

of tax indexing, reducing taxes, and giving financial bonuses to older workers); and, more cohesively, enacting measures that favour knowledge sharing between older and younger workers (experience versus technological skills, lifelong learning, greater proportionality in tax distribution between workers, inactive individuals, and pensioners, and increasing the activity rate of the population).

It is important to emphasize, however, that Portugal is not a homogeneous country. All these recommendations and intervention policies in the sectors mentioned must always take regional diversity into account. This is an aspect that is often overlooked due to the lack of access to more disaggregated statistical data. Although such data exists, it is not widely available, which hampers studies at a more micro-level geographically. Including this regional dimension will enable a more precise and effective approach, ensuring that policies are tailored to the specific needs of each area of the country.

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