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Is the statutory retirement age contributing to youth unemployment? - The case of Portugal

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Resumo

Portugal é um dos países mais envelhecidos da Europa. A pressão exercida sobre as finanças públicas devido a uma maior proporção de idosos – e, consequentemente, de reformados – está a ser colmatada, em certa medida, com políticas públicas destinadas ao aumento da idade legal da reforma. Ao mesmo tempo, Portugal regista uma taxa de desemprego jovem sistematicamente elevada. Num contexto de envelhecimento populacional, estará a idade legal da reforma a contribuir para o desemprego jovem, na medida em que mantém os trabalhadores no mercado de trabalho até mais tarde? Recorrendo a dados trimestrais entre 1992 e 2021, e a métodos econométricos distintos, os resultados sugerem o oposto: trabalhadores mais jovens e trabalhadores mais velhos parecem atuar como complementos no mercado de trabalho, e não como substitutos. De acordo com os resultados obtidos, um aumento do emprego dos mais velhos leva a um aumento do emprego jovem e a uma diminuição do desemprego jovem. Esta última relação só é significativa a partir de 2013, após o fim da crise económica e das políticas de combate ao desemprego que daí advieram. Ademais, é possível observar resultados distintos de acordo com o género, com a região e com o nível de educação.

Palavras-chave: Desemprego Jovem; Emprego Jovem; Mercado de Tabalho; Segurança Social; Pensões.

Classificação JEL: C22, J21.

Abstract

Portugal is one of the most ageing countries in Europe. The pressure on public finance exerted by a higher share of older - and, consequently, retired - people is being filled, to some extent, with public policies aimed at increasing the statutory retirement age. At the same time, Portugal registers a systematically high youth unemployment rate. In a context of ageing population, is the minimum statutory retirement age playing a role on the unemployment of younger people, by keeping older people in the labour market for longer? Using 1992-2021 quarterly data and distinct econometric methods, estimates suggest the opposite: younger and older workers seem to act as complements in the labour market, rather than as substitutes. The results shed light on the relationship between both age groups in the labour market: increases in the employment of older people lead youth employment to increase and youth unemployment to decrease. The latter relationship is only significant after 2013, with the end of the economic crisis and subsequent policies to fight unemployment. There is evidence of distinct patterns according to gender, region and educational attainment.

Keywords: Youth Unemployment; Youth Employment; Labour Market; Social Security; Pensions.

JEL Classification: C22, J21.

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1 Introduction

Bearing in mind the demographic, institutional and labour market characteristics of Portugal, this study is built on the research question of whether the imposition of a statutory retirement age (SRA) is driving the high levels of youth unemployment, in a context of ageing population. When did this story started and what has changed so far?

Since it was introduced in 1984, the Portuguese Basic Law of Social Security introduced a SRA for old-age pensions: 65 years for men and 62 years for women. Nine years later, in 1993, the Portuguese government changed the legal framework of social security's general regime, namely by equalizing men and women SRAs for old-age pensions at 65 years. Although, through the following years, the Portuguese SRA has not registered significant increases - it increased to 66 years in 2014 and, since 2016, it increased by one month per year, reaching 66 years and 6 months in 2021 -, the age-composition of the Portuguese population significantly changed. While, in 1984, people with 65 or more years composed only 12% of the country's resident population, that proportion escalated to 22% in 2020. As expected, this demographic dynamics is reflected in the number of people that benefit from old-age pensions every year: between 1990 and 2020, the number of people benefiting from old-age pensions increased by 56%.

As more old-age pensions need to be paid, contributions need to keep entering the system. Where these contributions come from is an important piece of the puzzle. The Portuguese public pension system is organized on a pay-as-you-go (PAYG) basis, in which pensioners' retirement benefits - namely old-age pensions - are financed by current workers' contributions - a logic of inter generational solidarity. However, population ageing has been posing financial sustainability challenges on this kind of pensions systems in the medium and long-term, as an increasing number of pensioners will pressure social security's budget, if workers' contributions cannot keep up with increasing pension expenditures.

Apart from Portugal, the financial sustainability of the public pensions' system has been imposing challenges across many European countries and policymakers have long been searching for measures to mitigate this problem, one of them being the increase in the SRA. As a matter of fact, within the European Union, this was the most common measure to address pension sustainability challenges over the last years, as almost all countries have legislated increases in the SRA (Carone et al., 2016).

Indeed, increasing the SRA is often seen as problem-solver on what concerns financial sustainability, given that, on the one hand, it increases revenues by increasing the size of the working population as older workers are retained in the labour market and, on the other hand, it decreases expenditures by reducing the number of pensioners (Kuitto & Helmdag, 2021, as cited in Bonoli, 2000).

However, imposing a SRA does not mean that every worker will retire at that age. There are other

policies that, either by benefiting/penalizing longer working careers or early retirement, may influence the effective retirement age (ERA). In Portugal, there are policies that: a) benefit longer working careers by giving a pension bonus for every additional month of work after completing the SRA; b) allow early retirement, for instance for workers that have laborious professions, like miners; c) allow early retirement, but with penalties - for instance, currently, a worker aged 60 and with 40 years of paid contributions may ask for early retirement, but with a penalization of 0.5% for each anticipation month relatively to the SRA. In Portugal, the average ERA tends to be slightly lower than the SRA both for men and women. Nevertheless, a higher SRA tends to contribute to a higher ERA (Kuitto, K. & Helmdag, J., 2021) and, therefore, policies regarding the imposition of an SRA affect the age-composition of the labour market.

It is important to ask, however, how does the labour market absorb young people if those already in the labour market tend to have longer working lives? Are young people being left aside the labour market? This thesis investigates whether a higher participation of older people in the labour market - as a consequence of the imposed statutory retirement age - is contributing to youth unemployment in Portugal. The study covers the period between 1992 and 2021, using quarterly data.

Since the beginning of the century, the youth unemployment rate started to rise without precedents in Portugal: from 9% in 2000 to reach 38% in 2012 to then decrease to 23% in 2020, yet still high. Although the Portuguese youth unemployment rate was below both the EU-27 and EA-19 averages in the beginning of the century, since 2007 it started growing to reach levels way above the EU-18 and the EA-19 averages and remains above them nowadays.

While the Portuguese youth unemployment rate was increasing and the youth employment rate was decreasing, the older employment rate increased by approximately 10p.p. between 2000 and 2020. This is reflected in the age structure of the employed population, which significantly changed in the past decades. Although there might be many factors on which the labour market participation of both groups may depend on, this may be indicative of a trade-off between both age groups in the labour market.

Despite its policy relevance, the impact of the SRA on youth unemployment lacks empirical research. Moreover, from the existing literature, the conclusions are not unanimous. While there is evidence suggesting that retaining older workers in the labour market for longer time will not negatively impact on the employment of the young (Gruber & Wise, 2010), there is also evidence suggesting that delayed retirement eligibility contributes to lower youth employment (Bertoni & Brunello, 2020).

Thereby, this thesis is contributing to close a gap on the labour market literature, more specifically on what regards the trade-off between the participation of the young and the old in the labour market. On the one hand, it studies the Portuguese case, a country not yet covered by literature, but

an interesting one to study given its labour market and demographic specificities. On the other hand, it enriches the literature by providing an analysis of this relationship not only in aggregate terms, but also detailing how this trade-off changes when distinguishing between gender, region and educational attainment.

As will be seen further on, a first Ordinary Least Squares (OLS) estimation was developed, in order to compare with a set of papers in the literature. Some considerations about the variables' properties led to a subsequent Newey-West (NW) robust estimation, where the results suggested that the legislated SRA, although keeping older people in the labour market for longer time, does not harm unemployment neither employment of the young. The same NW robust estimation was applied by gender, educational attainment and region, pointing out to the same the conclusions. Following endogeneity concerns generally found in literature, it was finally estimated a model through an Instrumental Variables (IV) approach, that confirmed the previously obtained results. The evidence shows that the employment opportunities for the young do not decrease as a result of more old people employed; instead, the results show that - after controlling for the economic cycle and for the percentage of young people who have completed at least upper secondary education - increases in the employment of older people lead youth employment to increase and youth unemployment to decrease. The relationship with youth unemployment is only significant after 2013, with the end of the economic crisis and subsequent policies to fight unemployment. As one will see, there are distinct patterns according to gender, region and educational attainment.

The remaining of the thesis is organized as follows. Section 2 briefly reviews the existing literature on the relationship between the employment of older people and youth unemployment. Data and methodology are described in Section 3. Then, Section 4 presents the estimation results. Section 5 concludes.

2 Literature Review

As rising concerns with the financial health of pension systems emerge, one common solution is to raise the retirement age (Boersch-Supran, 2014). On the one hand, it increases revenues, by increasing the size of working population, as older workers are retained in the labour market for longer and, on the other hand, it decreases expenditures, by reducing the number of pensioners (Kuitto & Helmdag, 2021, as cited in Bonoli, 2000). However, along with an increase in the retirement age, comes the concern that keeping older workers in the labour market for longer may crowd out young people from the labour market, thus contributing to youth unemployment (Boersch-Supran, 2014).

Nevertheless, the idea that increased participation of older workers in the labour market will decrease employment opportunities for the young is often criticized at the light of the 'lump of labour fallacy' (Wolla, 2020) or 'boxed economy' view (Boersch-Supran, 2014). The 'lump of labour fallacy' is the idea that there is a fixed number of jobs in the economy and, therefore, that the employment of one group means the unemployment of another group - for instance, that the employment of older workers means the unemployment of the young (Gruber et al., 2010). However, the critique often made is that labour demand is not fixed and, thus, that keeping older workers in the labour market for longer does not harm youth employment (Boheim & Nice, 2019). This critique finds support in the literature, as there is evidence suggesting that older employment does not "crowd out" youth employment (Munnell & Wu, 2013).

Moreover, there is also evidence suggesting that elderly participation in the labour market may even spur youth employment. In a volume edited by Gruber et al. (2010) , researchers analysed the relationship between the labour force participation of both age groups in twelve countries (Belgium, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, United Kingdom and the United States). In half of them, researchers found, to some extent and under certain assumptions, a positive relationship between the employment of both age groups (see, for instance, Salem et al., 2010 and Börsch-Supan & Schnabel, 2010). More recently, Carta et al. (2021), when studying the impact of a 2011 pension reform in Italy that increased the minimum retirement age, also concluded that an increase in the share of older workers would increase the number of younger workers employed, thus pointing out to the complementarity rather than to the substitutability between younger and older workers.

The conclusions found by Carta et al. (2021) reinforce an additional argument often used to lash out the proposition that more older workers in the labour market may reduce youth employment. The argument is that employees of different ages are imperfect substitutes (Fitzenberger & Kohn, 2006) and, therefore, that older workers are not taking jobs from the young, because the latter do not have the needed technical skills to perform the jobs of the former. Even if a higher SRA increased

firms' labour costs because of the negative impact of seniority on the profitability of older workers, firms would only have limited ability to substitute older with younger workers (Boheim & Nice, 2019).

So, does the literature so far totally "condemns" the hypothesis that increased labour force participation of older people reduce the job opportunities for the young? The answer is: no. Although the body of research on the trade-off between the employment of both age groups is not vast, it is extensive enough to include views that contrast with the ones above mentioned.

On the volume edited by Gruber et al. (2010), when studying the Spanish case, Boldrin et al. (2010) conclude that, although weak, there is evidence suggesting that the employment level of the young is positively related with the exit of older workers from the labour force. Additionally, when studying the United States, Gruber and Milligan (2010) find evidence of crowd-out - although also weak , as higher retirement incentives for the elderly appear to be related to more employment by the young.

Additionally, more recently, Bertoni and Brunello (2020) showed that, in the Italian labour market, delayed retirement eligibility reduces youth employment; the authors quantitatively confirmed that, by keeping older workers in the labour market, there will be less employment opportunities for the young. These results are in line with Boeri et al. (2022), who found that a forced retention of older workers in the Italian labour market, due to an unexpected increase in the retirement age, negatively impacts on youth employment: for every 5 older workers retained, firms reduced employment of young workers by 1 unit.

Furthermore, even considering that labour demand is not given in an economy - and, thus, that youth employment can raise even when elderly employment raises , there is a set of reasons why an increase in the SRA may affect firm behaviour and labour demand in such a way that it penalizes younger people, one of them being that such increase forces firms to retain workers for longer than initially expected and, as a response, firms may reduce new hirings for the sake of profitability (Martins et al., 2009). Indeed, following the 1993 Portuguese pension reform that increased women' SRA from 62 to 65 years old, those firms which employed older female workers significantly reduced new hirings, particularly of younger female workers (Martins et al., 2009). More recently, Ferrari et al. (2022) also studied how firm behaviour was affected after reforms that increased the SRA, but in the Netherlands. Their main findings were that firms employing older workers directly affected by those reforms responded by delaying the hiring of new workers, with younger workers explaining approximately half of the overall decrease in hiring rates.

At this point, one can separate the core literature on the relationship between the participation of the young and the old in the labour market in two main groups with opposite findings: older employment crowds out youth employment (Bertoni & Brunello, 2020); older employment does not crowd out youth employment (Munnell & Wu, 2013). The set of papers in Gruber et al. (2010) are either in

the first or in the second group, depending on the country under study. As this work will draw on the previously mentioned literature, it is important to discuss the methodologies used so far.

2.1 Methodological aspects

More than studying the relationship between the employment dynamics of younger and older people, this work aims to go further, and establish a link between the (un)employment of younger individuals and those individuals who stay in the labour market because there is a legislated SRA, who prevents them from leaving the labour market. For that matter, this thesis draws on Bertoni and Brunello (2020), who brought up an innovation when compared to Munnell and Wu (2013) and the set of papers edited by Gruber et al. (2010). Whereas the last two typically consider as "old" those individuals who have between 55 and 64 years old, Bertoni and Brunello (2020) introduce variation in the key explanatory variable as they consider, in each year, only the individuals who have, at most, an age equal to the minimum retirement age (MRA) in that year: here, the concern shifts from a mere question of being old or not, to a question of being pension-eligible or not. This is a crucial aspect, since a static age-range would not capture the effects of changing statutory retirement ages. In order to measure the impact of more old people employed on the labour market outcomes of the young, in 1992, for instance, calculating the old employment rate with a static range of 55-64 years old, would not measure the true effect of the legislated SRA in Portugal: the legislated SRA was 62 years-old for women and 65 years-old for men, thus one would be over-estimating the impact of female older employment and under-estimating the impact of male older employment. By introducing variability in the key explanatory variable, however, such concern is addressed by considering an upper age limit equal to each year's SRA - in 1992, it would be 62 for women and 65 for men -, a distinction that is only possible by resorting to micro data.

On what concerns the definition of "young", it is consensual among Munnell and Wu (2013) and the set of papers in Gruber et al. (2010) to generally consider the age group between 20-24 years old. Although those aged between 16-24 years old are considered as "very young" and not as "young" in Bertoni and Brunello (2020) - who consider as "young" those individuals who have between 25-34 years old -, the conclusion is the same for both age groups: the increase in the retirement age led to a fall in employment not only for the young, but also for the very young.

It is also worth noting that, even though the estimation method used is an OLS regression, the dependent and independent variables are not always the same across the literature. On the volume edited by Gruber et al. (2010), the key explanatory variable varies between the employment rate of the old and the labour force participation of the old, and the dependent variable is considered to be one of three: youth employment rate, youth unemployment rate and the educational participation of the

young. As for Munnell and Wu (2013), the employment rate of older people is the key independent variable to explain four distinct dependent variables: the employment rate, the unemployment rate, hours worked, and the average wage rate and earnings of young people. Last but not least, Bertoni and Brunello (2020) estimate how the "pool of senior individuals aged 50+ who are not eligible to retire because they are younger than the MRA" change the employment or unemployment levels of distinct age groups (young, very young, prime age and senior) - measured in thousands of individuals.

When estimating the direct relationship between the participation of both age groups in the labour market, one should notice that there might be variables influencing both. In order to isolate the causal effect of older employment/labour force participation on youth labour market outcomes, there is consensus in the literature about controlling for variables related with economic growth, like GDP per capita or GDP growth (Gruber et al., 2010; Munnell & Wu, 2013; Bertoni & Brunello, 2020). Such choice finds grounds on empirical research: Okun (1962) uncovered a negative relationship between output growth and the change in the unemployment rate. There is a wide range of control variables in literature, namely: GDP per capita; GDP per capita growth; share of GDP coming from manufacturing; gross national product (GNP); GNP growth; share of employment in manufacturing; share of employment in service industry; share of self-employment; an index that represents the employment share of the production sectors with a higher than average share of youth employment; average unemployment rate; average wage; effective minimum wage; average age; local population; share of individuals with at least high school; share of individuals with less than high school; share of males; share of immigrants in local population; share of black people; share of poor people; share of young individuals; housing price index growth. Munnell & Wu (2013) draw on the highest number of control variables, which may arise over-fitting issues.

Although, more recently, the stability of the coefficient of Okun's Law has been challenged by literature (Aguiar-Conraria et al., 2020), it still presents itself as a strong and stable relationship in most countries, although the negative effect of a 1% change in output on the unemployment rate varies across countries (Ball et al., 2017).

However, even after using control variables, there still might be unobserved factors that simultaneously impact youth (un)employment and older employment, thus allowing for the presence of endogeneity in the model (Munnell & Wu, 2013). When present, endogeneity - either through omitted variables, measurement errors or simultaneity - violates the Gauss-Markov assumption of exogeneity, thus making the OLS estimator biased and inconsistent (Wooldridge, 2012), which ultimately compromises the obtained results. In order to address such problem, an instrumental variable approach is used in the literature, although the instrumental variable chosen varies across authors. In the set of papers in Gruber et al. (2010), it is estimated an index aimed at measuring the incentives to leave the

labour force, ie. an incentive to retire, grounded on the argument sometimes raised by policymakers that, by introducing incentives for older people to retire, the job prospects for younger people will be improved. This index relies on some assumptions made by the authors and, in general terms, it is based on the concepts of social security wealth (SSW) and peak-value, which represent, respectively: the discounted present value of social security benefits received from the moment of retiring until death; the maximum SSW an individual can obtain by optimally choosing the time of retirement between the current moment and the statutory retirement age. Munnell and Wu (2013) chose the older male mortality rate, based on evidence that relates poor health status with early retirement, at the same time that the mortality rate of older people has no direct effect on the (un)employment of the young - a condition that needs to be verified in order for the variable to be used as an instrument. A different approach was the one followed by Bertoni and Brunello (2020), who adjusted their key explanatory variable ("local pool of individuals older than 50 but younger than minimum retirement age") and, instead of applying the minimum retirement age to each year's local population, the authors applied it to the 1991 local population structure and used it as an instrument. The authors' justification is that the "local pool of individuals older than 50 but younger than minimum retirement age" is not only affected by pension reforms, but also by endogenous mobility and by demographic factors, thus the instrument allows to isolate "the local changes induced by variations in minimum retirement age from demographic changes and mobility across local areas".

A not yet mentioned, even though relevant, aspect to consider is the time period covered. On the volume edited by Gruber et al. (2010), the time spans differ across countries: the longest period is from 1960 to 2006 (in Germany) and the shortest period from 1983 to 2004 (in Belgium). A novelty introduced by Munnel and Wu (2013), who use yearly data from 1977 to 2011, is to study if the conclusions change in the period dominated by the Great Recession by constructing a dummy variable. The impact of the Great Recession is also assessed by Bertoni and Brunello (2020). The authors acknowledge that the studied period - from 2005 to 2016 - is dominated by the Great Recession and its consequences, characterized by declining GDP and total employment; therefore, they re-estimate the model using data from 1996 to 2016, thus capturing the period 1996-2017, a period characterized by growing GDP and total employment. The conclusions are similar: Munnell and Wu (2013) concluded that the impacts of older people's employment during the Great Recession do not differ from those during typical business cycles; Bertoni and Brunello (2020) found that the effect of a higher minimum retirement age on the (un)employment of very young people kept the same direction and its magnitude remained virtually unchanged.

Because the dynamics of employment may differ when considering the country as a whole and when considering particular regions, this work aims at studying the relationship between the em-

ployment of the old and of the young both at the national level and at the regional level. The concern for spatial variation is also present in Munnell and Wu (2013) as the authors draw on state-level data for the USA case, as well as in Bertoni and Brunello (2020), who study Italy by relying on 102 provinces, based on NUTS III level data. Nevertheless, the authors do not analyse the results at the state/province level in none of the cases. Therefore, this thesis sheds light on how this relationship might change when considering, on the one hand, the national case and, on the other hand, local labour markets defined by NUTS II level data.

Also, this work intends to answer if such relationship changes based on individuals' educational attainment, a concern demonstrated in Munnell and Wu (2013), given that "groups with similar skills can be more easily substituted". This work will study Portugal, a country not yet covered by literature.

Even though the literature is scarce on this matter, the linkage between youth (un)employment and older people' extended working lives should not be disregarded, especially given the current economic and demographic scenarios. On the one hand, the ongoing and intensifying population ageing was identified as "the most serious and an enduring challenge for developed and developing welfare states" (Hinrichs, 2021), and it is intimately linked with pension reforms that increase the SRA and that, consequently, extend working lives. On the other hand, Mroz and Savage (2003) show that there exist long-term impacts on earnings from unemployment experienced early in the employment lifecycle: wage differentials are quite large and persistent over time. This wage penalty and the damaging effects on future employability arising from youth unemployment remain even after controlling for individual worker characteristics like education and region (Gregg & Tominey, 2005).

3 Empirical Approach

3.1 Data

This analysis draws mainly on micro data taken from Inquérito ao Emprego (IE), a quarterly employment survey conducted by Instituto Nacional de Estatística (INE), the Portuguese statistics agency. The survey's sample dimension follows the criteria defined in European harmonized guidelines, resulting in a sample of around 40.000 to 50.000 inquired individuals per quarter, which represents about 0.5% of total population. The extrapolation from the survey's sample to the population is based on an individual weight attributed by INE to each inquired individual. Since it has a quasi-longitudinal nature (each quarter, one sixth of the sample rotate out of the sample), this survey enables to assess the evolution of the labour market, at the same time that it reduces the burden on respondents, thus promoting the quality of information provided. Moreover, besides quantitatively characterising active population (employed and unemployed) and inactive population, it also allows a qualitative characterisation of both populations, since the respondents are asked not only to provide information on their employment status, but also on individual characteristics like age, gender and educational attainment.

The option for using micro data relies mainly on two reasons. First, as already mentioned, the goal of the paper is not to merely study the impact of the old on the (un)employment of the young: it intends to capture the effect of the legislated SRA on the employment of the old. This is relevant because the old employment rate publicly available considers the age range 55-64 years old. However, as mentioned before, the key explanatory variables of this thesis are a) the employment rate of people aged between 55 years and the SRA, and b) the employment rate of people aged between 55 years and the ERA. Since both the statutory and effective retirement ages change along the years, it would not be possible - with publicly available data - to truly capture the effect of the legislation on the labour market outcomes of the young. Second, the disaggregation level of available statistics was sometimes not enough - not only regarding the frequency of the data, that sometimes was not available on a quarterly basis (e.g. employed and unemployed population are only available on an yearly basis from 1992 to 1997), but also regarding attributes that were going to be needed in order to study the distinct disaggregations (e.g. no information regarding the educational attainment of unemployed people, thus not being possible to study whether old employees with a certain educational attainment are contributing to the unemployment of young individuals with that same level of educational attainment).

The software used to select and clean IE's micro data was SAS Enterprise Guide (SAS, henceforth). Together, the micro data files accounted for more than 20 million registers, in which there were 120

reference periods, one for each quarter, thus a total of 30 years of quarterly data. Given the amount of data, all steps were ran on a programming basis instead of the menu-driven tool, in order to turn processes faster, easier, repeatable and less prone to human errors.

The cleansing of the data started with eliminating registers where the interview year was either before or after the reference year (e.g. 1992Q1 as reference period, but 1982 or 1999 as interview year), as this situation did not seem plausible. Nevertheless, this happened only between 1992 and 1997 and, in each reference period, the eliminated registers represented merely 0.1% to 1% of total registers. After having the complete micro database, the next step was to start calculating the variables of interest at each quarter. In Table 1, all variables with primary source "IE" were calculated in SAS. The remaining ones are based on macro data publicly available.

Table 3.1. Variables' description and sources

Variable	Description	Unit	Primary source	Frequency
Youth unemployment rate	Number of unemployed people (16-24 years old)/Labour force (16-24 years old) * 100	%	IE	Quarterly
Youth employment rate	Number of employed people (16-24 years old)/Resident population (16-24 years old) * 100	%	IE	Quarterly
Old employment rate (55-SRA)	Number of employed people (55-SRA years old)/Resident population (55-SRA years old) * 100	%	IE	Quarterly
Old employment rate (55-ERA)	Number of employed people (55-ERA years old)/Resident population (55-ERA years old) * 100	%	IE	Quarterly
Gross domestic product (GDP) per capita	Chain-linked volumes (2010), euros per capita	€ per capita	Eurostat	Quarterly
GDP per capita (homologous growth rate)	Chain-linked volumes, percentage change compared to the same period in previous year, per capita	%	Eurostat	Quarterly
Share of young individuals	Number of young people (15-24 years old)/Resident population * 100	%	IE	Quarterly
Minimum wage variation	[(Minimum wage at quarter t+1 / Minimum wage at quarter t) -1] * 100	%	DGERT/ MTSSS	Quarterly
Share of employment in tertiary sector	Number of employed people in the tertiary sector / Number of employed people * 100	%	IE	Quarterly
Share of employment in manufacturing sector	Number of employed people in the secondary sector / Number of employed people * 100	%	IE	Quarterly
Share of self-employment	Number of self-employed people / Number of employed people * 100	%	IE	Quarterly
Share of young people with at least upper secondary education	Number of young people (20-24 years old) with at least intermediate education level /Resident population (20-24 years old) * 100	%	IE	Quarterly
Old mortality rate	[Deaths between *t-1* and *t* (55-64 years old) / Average resident population between *t* and *t-1* (55-64 years old)] * 100	%	INE	Yearly

Over the past few years, IE suffered some methodological changes, some of them with impacts on how the data was cleansed and processed. For the time period considered, there are four distinct series: 1992Q1 until 1997Q4; 1998Q1 until 2010Q4; 2011Q1 until 2020Q4; from 2021Q1 onward. By relying on micro data, it was possible to account for these methodological changes when calculating the variables of interest, thus guaranteeing that the data is harmonized and comparable over time. The main changes addressed in the SAS programming code were the following:

- The change in the minimum age to be considered as active population: in 1998, from 14 to 15 years-old; in 2021, from 15 to 16 years-old. Consequently, youth employment and unemployment rates were calculated, for all quarters, with 16 years-old as the lower age limit. Otherwise, direct comparisons between series were not viable.
- In 2008, it was adopted a new statistical classification of economic activities - the NACE-Rev.3. One of the survey's questions regards the main activity of the respondent's workplace, as defined by NACE-REv.3. Since this classification was needed to identify whether the respondent worked on the primary, secondary or tertiary sector, it was necessary to guarantee that these changes were acknowledged when selecting data.
- In 2011, it was adopted a new method of collecting data and it was introduced the new Portuguese Classification of Occupations (CPP-2010). Only the latter had impact on data selection, as explained in the next point.
- Since 2021, according to the 19th International Conference of Labour Statisticians, some economic activities stopped being considered as part of employment, namely agriculture and fishing activities exclusively for self-consumption. Similarly to the case of the change in the minimum age to be considered as active, this change also impacts on the calculation of employment rates - both young and old. Bearing this in mind, since only the data for 2021 acknowledges such change, for the remaining years there was the need to exclude those who were considered employed in such activities - this is done through a question related with CPP-2010. Together with the above mentioned in a), this methodological change contributes to the discrepancy that will be seen in Figure 3.1 in the next subsection.
- Changes in the survey's structure, in distinct years, in order to meet Eurostat's communal requirements, namely with the aim of harmonizing statistics at the European level. Although the the nature of the concepts on which the survey relies and intends to study remained essentially the same, the questions changed, and so did the available options to give as an answer, thus implying the analysis of how concepts and answers compare over time, in order to maintain the comparability of results.

Additionally, along time, there were also changes in legislation that played a role on data selection.

As already mentioned in Section 1, the Portuguese Basic Law of Social Security introduced, in 1984, a SRA for old-age pensions: 65 years for men and 62 years for women.

Then, in 1993, the Portuguese government raised women' SRA from 62 to 65 years, thus equalising the SRA for men and women. This change started producing effects in 1994, when women' SRA was set at 62 years and 6 months, then increasing by 6 months per year until reaching 65 years. While the old employment rate for men was calculated always with 65 years as the upper age limit, the old employment rate for women had different upper age limits between 1992 and 1999. Only with micro data it is possible to make such distinction, since the survey provides information on each respondent's gender and age. Otherwise, this change in legislation could not be acknowledged.

After that, in 2007, the Portuguese government aggravated the penalization of early retirement, which moves from 4.5% to 6% for each missing year until reaching the SRA, thus an incentive to keep older workers in the labour market for longer (Barradas & Lagoa, 2019). Even though this change does not impact on the SRA, it might produce an impact on the ERA; nevertheless, as showed in Figure 2, the ERA did not respond significantly. Conversely, in 2012, the suspension of the possibility to retire early for those under the regime of Social Security - justified by the Portuguese government with the need to reduce expenditures in the context of an economic crisis - did increase the ERA, approximating it to the SRA, as highlighted in Figure 2.

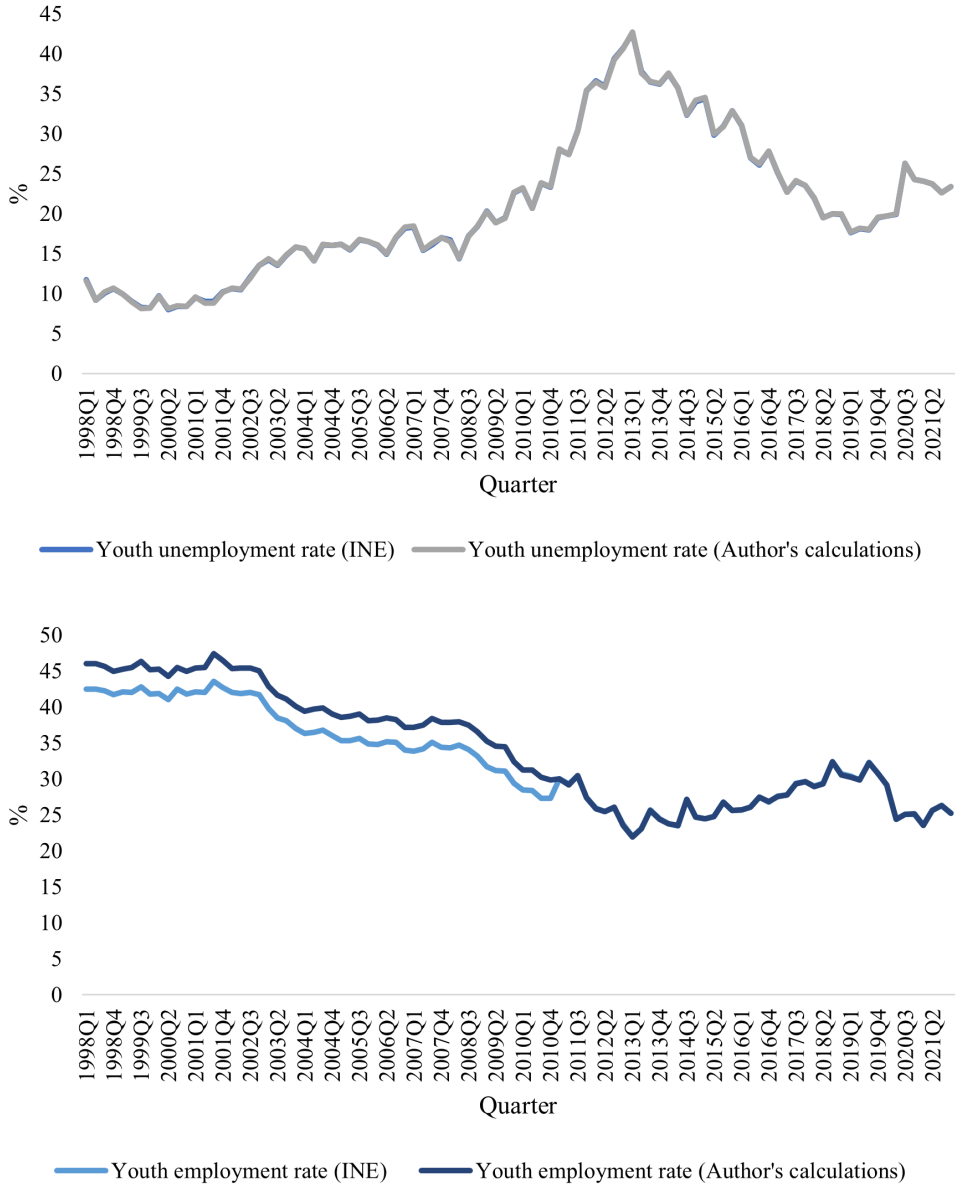
Two years later, in 2014, the SRA increased again, being fixed at 66 years - in the calculation of old employment rates, in SAS, it starts to be considered 66 years as the upper age limit. From 2016 onward, it varies according to evolution of the average life expectancy - to the age of 66 years it is added 2/3 of the increase in the average life expectancy between 2012 and the year correspondent to two years before the retirement date. With this formula, the SRA increases in the following years were of a few months, thus it is not possible to reflect such increases in the SRA chosen in micro data - for instance, the SRA in 2014 was 66 years, while in 2016 it reached 66 years and 2 months; however, in both cases, the upper age limit for the old employment rate must be 66 years. It is only in 2021, when the SRA increases to 66 years and 6 months, that the SRA rounds up to 67 years.

3.1.1 Calculation of dependent and main independent variables

As the structure of the survey suffered changes along the years - for instance, regarding the questions asked and the available options -, the calculation of the variables required extra caution. For the employment and unemployment rates, the key concepts that needed to be extracted from the micro data were "employed" and "unemployed", respectively. In order to do so, it was used INE's algorithm that characterizes individuals as "employed" or "unemployed" - which is provided by INE in methodological supporting documents - based on a combination of variables.

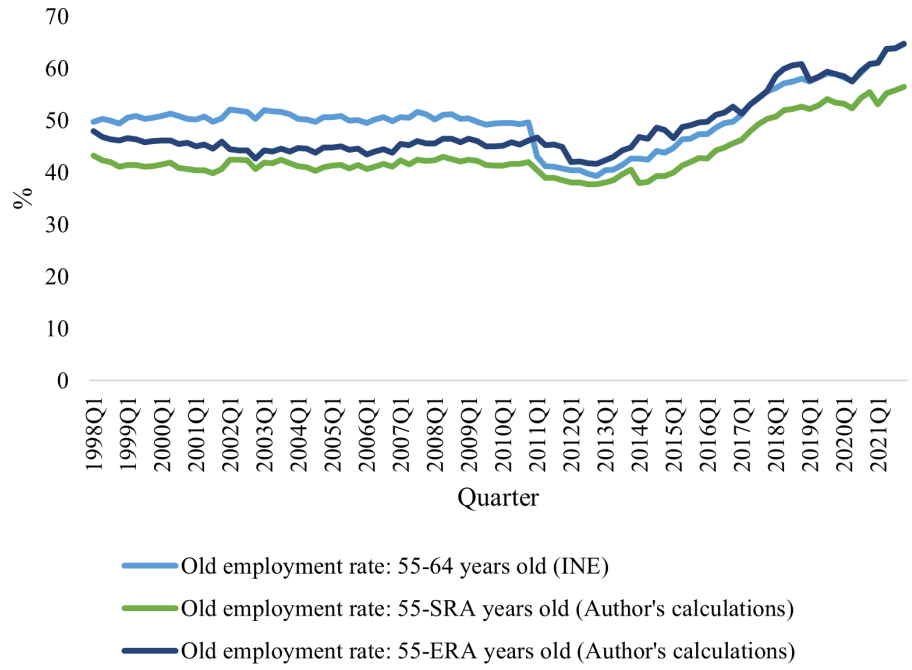
In order to compare the estimated and published values, Figures 4 and 5 plot both of them, allowing a better understanding of how they compare. By looking at Figure 3.1, one may observe that the estimated youth unemployment rate is almost perfectly coincident with the published one. On what regards the youth employment rate, after 2011 the estimated and published values are coincident. Before 2011, the values published by INE are not revised with the latest methodological changes, which may explain the upward drift of the estimated youth employment rate. Then, Figure 3.2 compares the old employment rate published by INE with the two old employment rates under study. Since the upper age limit is different, one would expect that the variable would not display exactly the same values. Nevertheless, they do present the same behaviour over time. This comparison only starts after 1998 because, before that year, INE does not publish these variables on a quarterly basis.

Figure 3.1. Youth unemployment and employment rates: published *vs* estimated values



Source: INE, Author's calculations

Figure 3.2. Old employment rates: published *vs* estimated values



Source: INE, Author's calculations

The descriptive statistics of the dependent and independent variables for the period 1992Q1-2021Q4 are presented in Table 3.2 and can be analysed in distinct sub-samples.

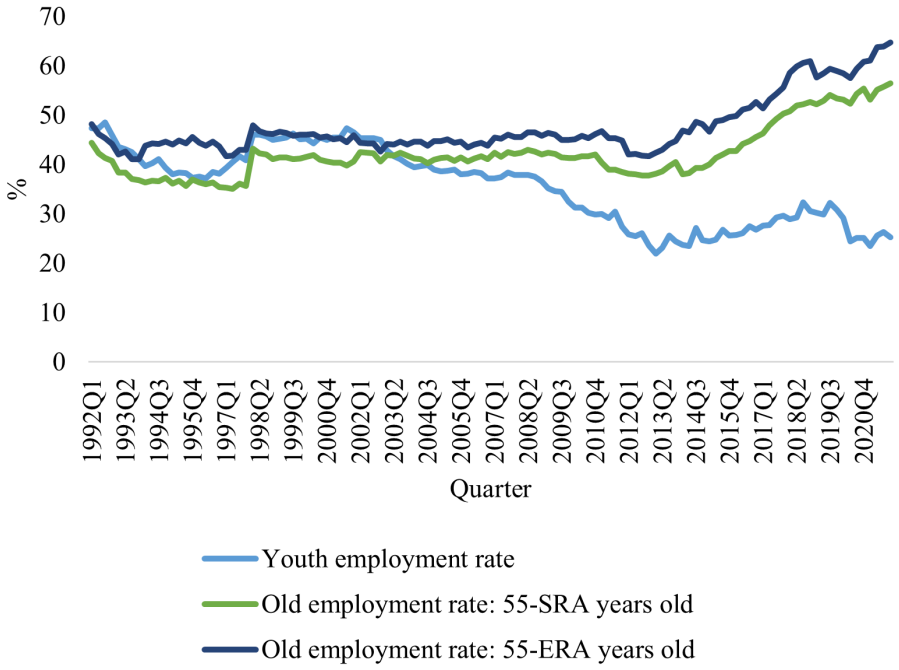
For the aggregated case - these statistics reflect 120 time observations. On average, the youth unemployment rate is 19% - ranging from 8% to 43% -, and the youth employment rate is 36% - ranging from 22% to 49%. The maximum youth unemployment rate and the minimum youth employment rate are both relative to 2013, a period of recession. Regardless of the limit age, the mean employment rate of *old* people (more than 40%) is higher than the mean employment rate of the young and it has a smaller value range over time. Figure 3.3 makes clear the distancing between the employment rates of both age groups: the youth employment rate was particularly affected after the 2008 financial crisis, decreasing to record minimum values and did not saw a full recovery so far. The employment rate of older people did not experienced such deterioration and, in fact, 2021Q4 marks the period with the highest old employment rate for the time span under analysis. As the denominator of the employment rate is the resident population, one may argue that the evolution of these variables is more related to demography issues, rather than labour market evolution. A deeper analysis reveals that the number of young individuals has been decreasing over time - a lower denominator, thus increasing the youth employment rate -, and so does the number of young employees - a lower numerator, thus decreasing the youth employment rate. Therefore, the decrease in the youth employment rate is mainly given by a decrease in the number of young employees. Regarding older people, the story changes: the number of individuals has been increasing, and so does the number of employees - the

higher old employment rate is mainly due to an increasing number of older employees.

Table 3.2. Descriptive statistics

	Mean	Std. Dev.	Min.	Max.
General case				
Dependent variables				
Youth unemployment rate	19.48	8.50	8.11	42.69
Youth employment rate	35.59	7.68	21.94	48.55
Independent variables				
Old employment rate (55-SRA)	42.29	5.19	35.09	56.47
Old employment rate (55-ERA)	47.50	5.66	41.07	64.73
Control variables				
GDP per capita	4062.36	328.62	3340.00	4740.00
GDP per capita (homologous growth rate)	0.89	3.47	-18.10	16.00
Share of young individuals	12.78	2.32	10.59	17.28
Minimum wage variation	4.11	2.11	0.00	11.00
Share of employment in services (tertiary sector)	64.41	5.71	53.04	76.84
Share of employment in manufacturing (secondary sector)	20.67	3.26	16.38	26.17
Share of self-employment	17.37	2.40	13.31	23.52
Share of young people with at least upper secondary education	57.30	16.59	32.08	91.00
Instrumental variables				
Old mortality rate	0.75	0.10	0.65	0.97
By gender				
Dependent variables				
Youth unemployment rate - Male	17.67	8.89	5.06	40.46
Youth employment rate - Male	39.03	9.04	23.35	53.07
Youth unemployment rate - Female	21.65	8.16	10.40	45.21
Youth employment rate - Female	32.03	6.39	19.19	44.00
Independent variables				
Old employment rate (55-SRA) - Male	51.06	5.11	41.82	62.74
Old employment rate (55-ERA) - Male	57.12	4.78	45.21	70.98
Old employment rate (55-SRA) - Female	34.60	7.36	24.99	53.68
Old employment rate (55-ERA) - Female	39.04	7.93	27.74	59.30

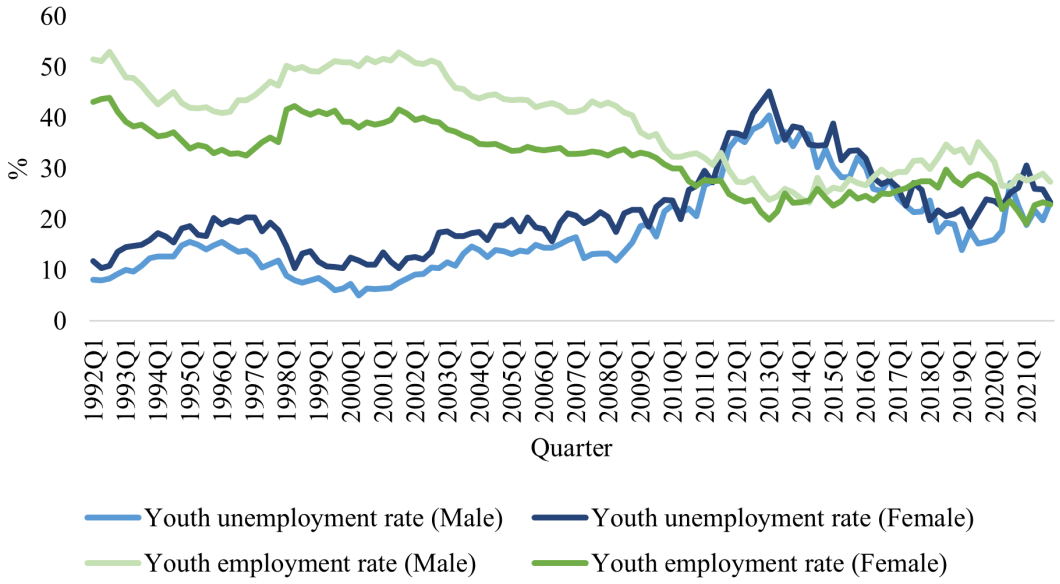
Figure 3.3. Youth *vs* old employment rates



Source: Author's calculations

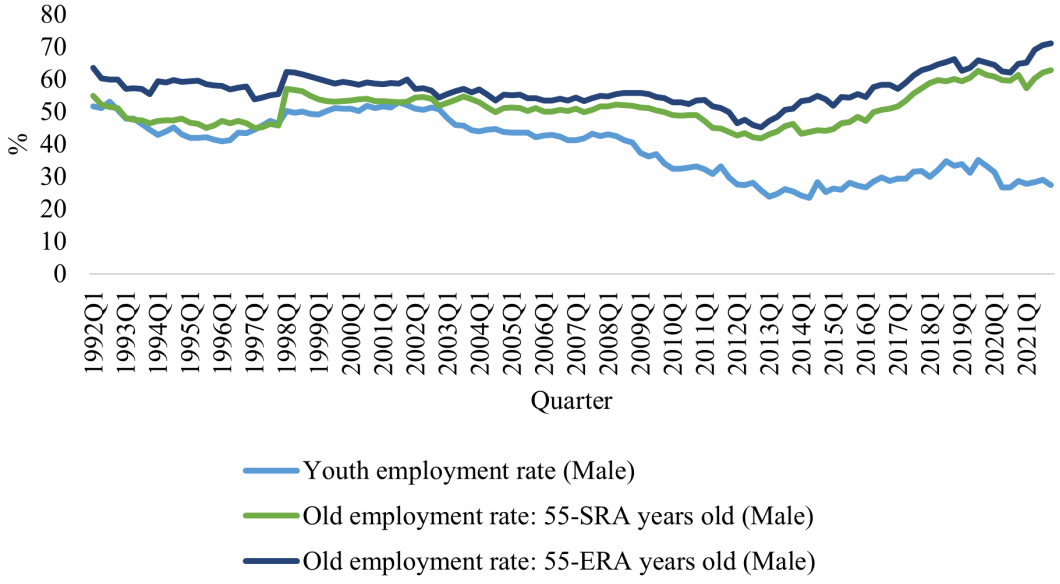
By gender - these statistics reflect 240 observations. On average, the youth employment rate is higher for men (39%) than for women (32%), while the youth unemployment rate is higher for women (22%) than for men (18%). The pattern is similar for *old* employment rates - men have higher employment rates than women. As highlighted in Figure 3.4, the youth unemployment rate for women is typically higher than for men (in blue), although they follow the same tendency over time. The employment rate, as expected, presents the opposite relationship: higher for men than for women (in green), but also co-moving over time. In Figure 3.5, one may observe that, as for the aggregated case, also by gender there is an increasing gap between the employment rates of young and old people. Only the male case is represented in Figure 3.5, but for the female case the overall picture is likewise.

Figure 3.4. Youth employment and unemployment rates - By gender



Source: Author's calculations

Figure 3.5. Youth *vs* old employment rates - By gender



Source: Author's calculations

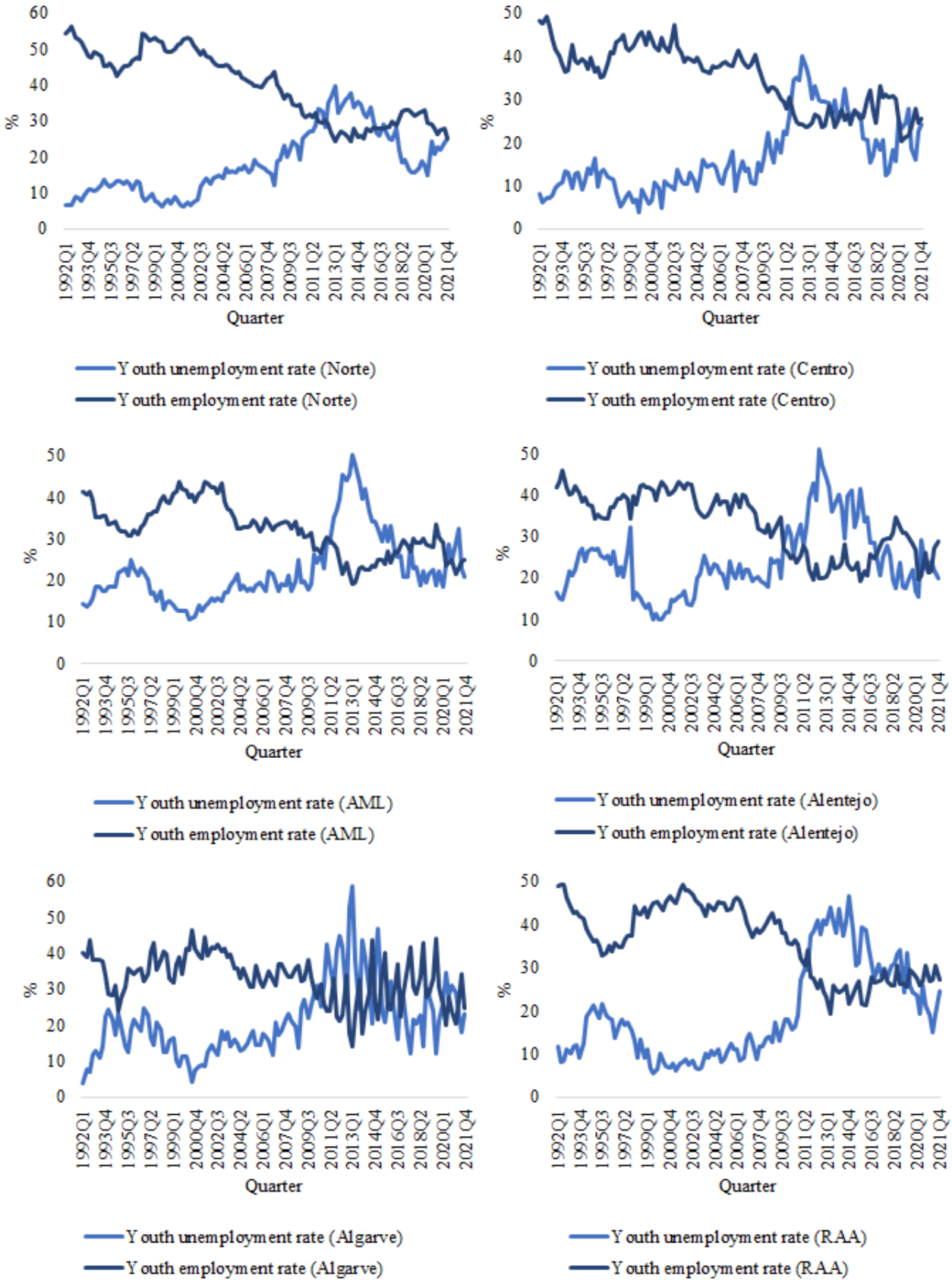
By region - these statistics reflect 840 observations. Following Eurostat's efforts to provide a single territorial classification in order to produce regional statistics, this study resorts to the NUTS' classification set by Regulation (EC) No. 1059/2003. More specifically, it is going to be used the NUTS II level as amended by Regulation (EC) No. 1319/2013, which divides the Portuguese territory in seven regions: Norte, Centro, Área Metropolitana de Lisboa (AML), Alentejo, Algarve, Região Autónoma dos Açores (RAA) and Região Autónoma da Madeira (RAM). Starting with the young, on average, the higher employment rate is registered in Norte (40%), while the lowest employment rate is registered in

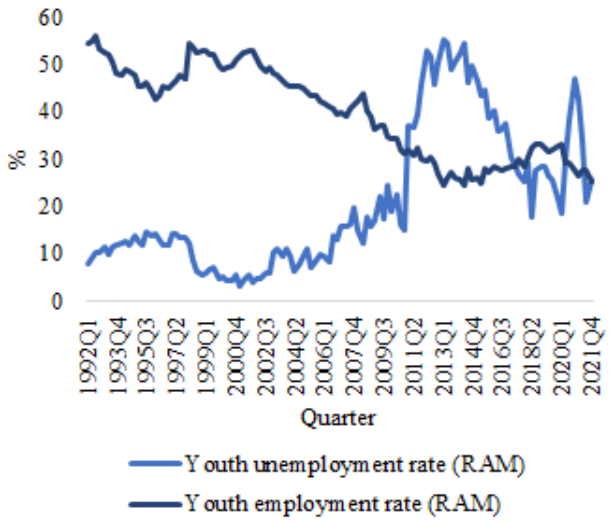
RAM (32%). Regarding the average unemployment rate, Centro registers the lowest one (17%), while Alentejo registers the highest one (24%). Moving on to the *old*, the pattern slightly changes: it is Algarve that registers the higher average employment rate, while the lowest one is in RAM and Norte, depending on whether the SRA or the ERA is considered as age limit. Figure 3.6 depicts the labour market for the young by region. As one may observe, in general, each region's youth employment rate tends to reflect the national paradigm: from 1992 to 2021, it fell from around 50% to around 25%, the steepest decline being in RAM. As expected, the youth unemployment rate tends to present the opposite behaviour of the youth employment rate and it remains in relatively high levels in all regions, although always below 2013 levels, where generally the peak was reached. As showed in Figure 3.7, employment rates are higher, in all regions, for older people.

Table 3.2. Descriptive statistics (continued)

	Mean	Std. Dev.	Min.	Max.
By region				
Dependent variables				
Youth unemployment rate - Norte	18.18	8.96	5.96	39.69
Youth employment rate - Norte	39.64	9.69	24.39	56.10
Youth unemployment rate - Centro	16.50	8.40	3.85	39.99
Youth employment rate - Centro	34.88	7.42	20.24	49.14
Youth unemployment rate - AML	22.41	8.50	10.56	50.33
Youth employment rate - AML	32.01	6.18	19.02	43.83
Youth unemployment rate - Alentejo	23.94	8.48	9.99	50.90
Youth employment rate - Alentejo	32.83	7.46	19.17	45.72
Youth unemployment rate - Algarve	21.11	10.10	3.91	58.58
Youth employment rate - Algarve	33.01	6.68	13.93	46.36
Youth unemployment rate - RAA	19.37	11.12	5.54	46.49
Youth employment rate - RAA	36.09	8.31	19.30	49.17
Youth unemployment rate - RAM	20.89	15.02	3.23	55.22
Youth employment rate - RAM	31.78	10.15	12.66	46.87
Independent variables				
Old employment rate (55-SRA) - Norte	38.25	5.35	32.22	53.45
Old employment rate (55-ERA) - Norte	43.07	6.13	35.30	61.89
Old employment rate (55-SRA) - Centro	42.01	7.44	26.44	59.29
Old employment rate (55-ERA) - Centro	47.35	7.47	31.24	66.53
Old employment rate (55-SRA) - AML	45.28	5.38	38.77	59.67
Old employment rate (55-ERA) - AML	51.02	6.21	42.84	67.51
Old employment rate (55-SRA) - Alentejo	44.95	5.56	33.66	60.18
Old employment rate (55-ERA) - Alentejo	50.40	5.74	40.68	66.69
Old employment rate (55-SRA) - Algarve	49.22	6.00	35.00	64.92
Old employment rate (55-ERA) - Algarve	54.18	6.05	42.00	70.60
Old employment rate (55-SRA) - RAA	38.22	6.93	25.28	54.57
Old employment rate (55-ERA) - RAA	42.12	7.88	27.90	59.94
Old employment rate (55-SRA) - RAM	47.42	5.31	36.36	60.19
Old employment rate (55-ERA) - RAM	51.90	5.29	40.26	65.68

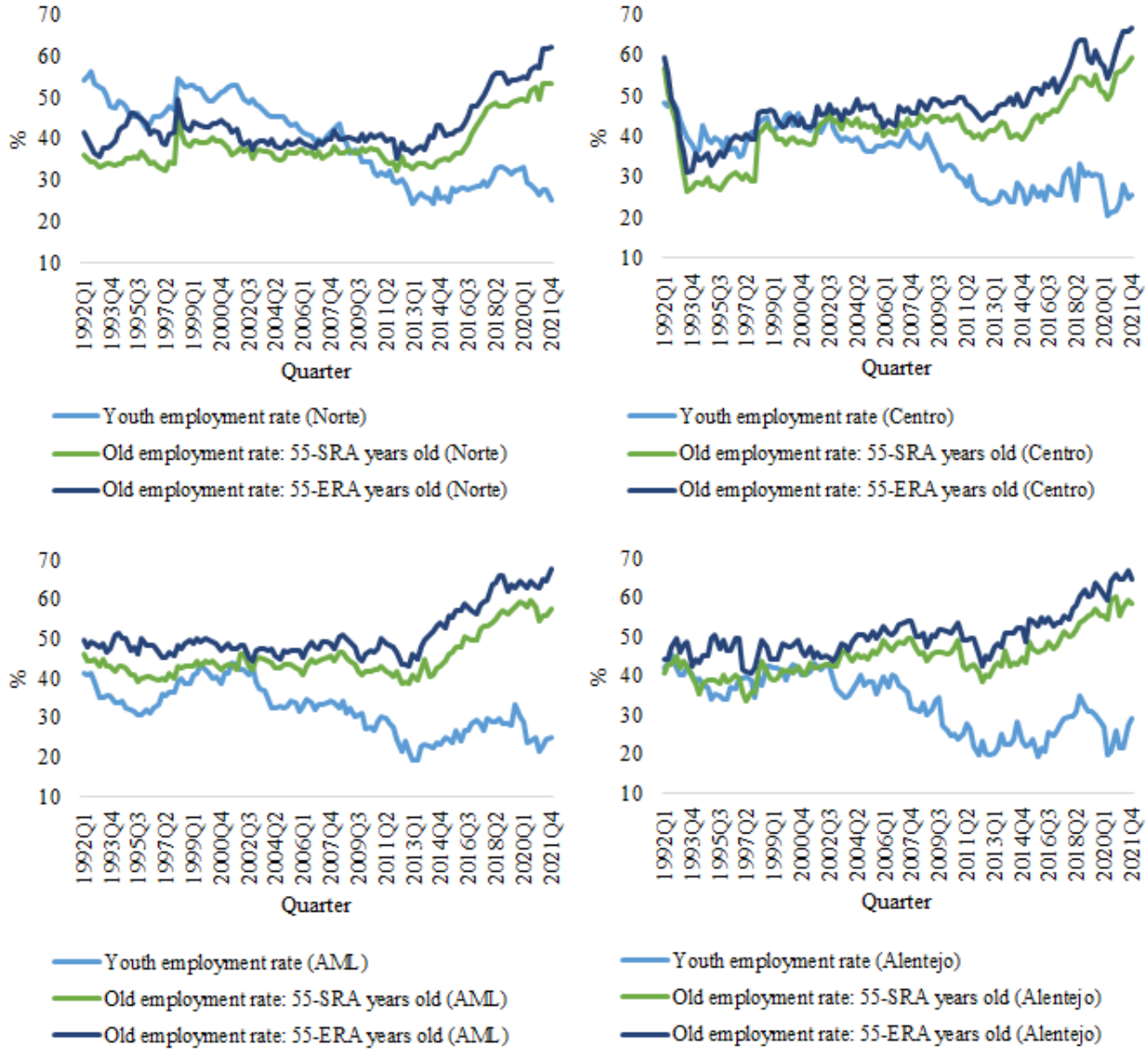
Figure 3.6. Youth employment and unemployment rates - By region

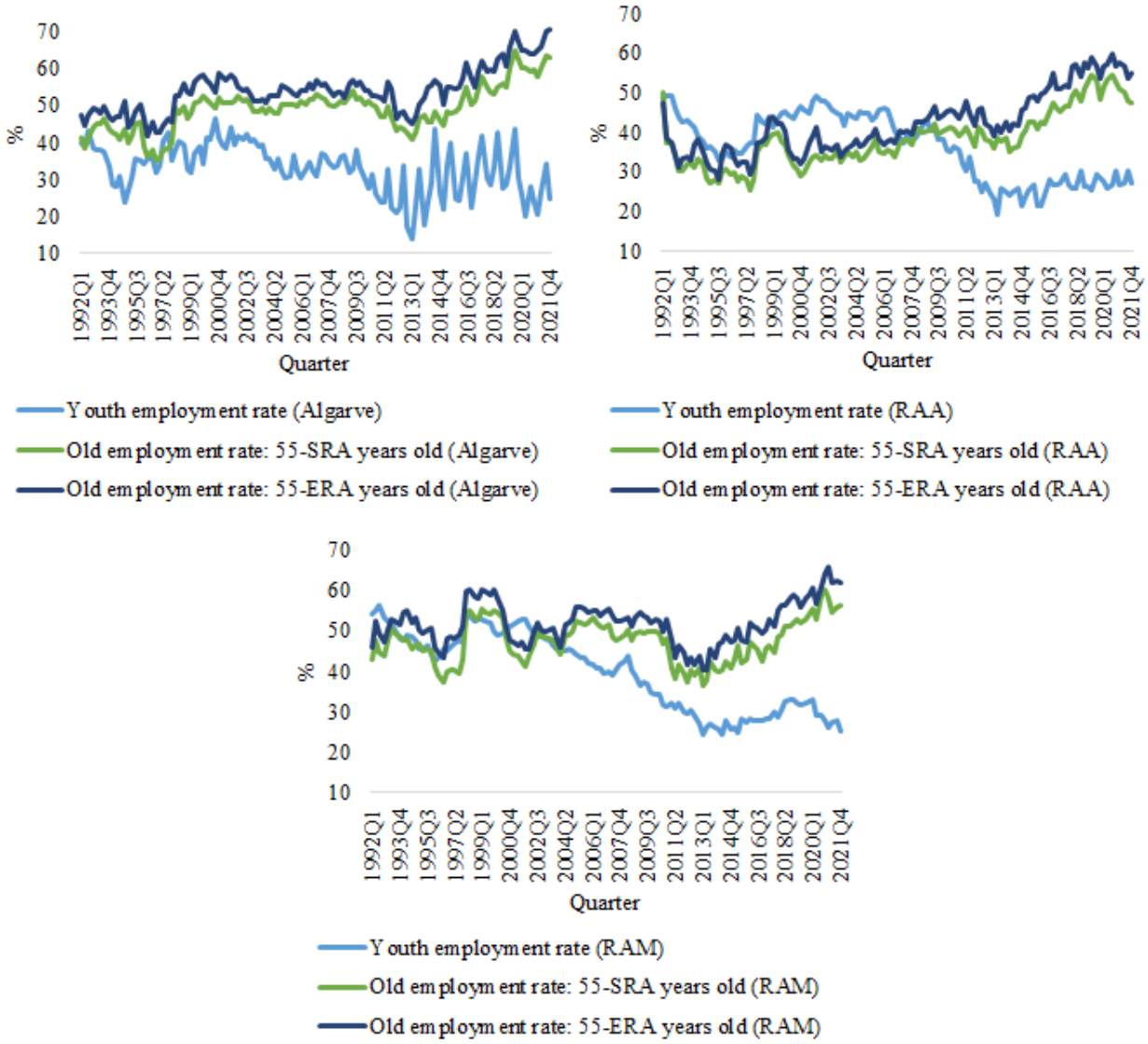




Source: Author's calculations

Figure 3.7. Youth *vs* old employment rates - By region





Source: Author's calculations

By educational attainment - these statistics reflect 360 observations. Following the definition of the International Labour Organization (ILO) - which, on its turn, draws on the International Standard Classification of Education (ISCED) defined by UNESCO, thus allowing for the international comparability of education's indicators and statistics (ILO, n.d.). -, it is considered three aggregate levels of education: basic, intermediate and advanced. Specifically, basic education goes up until the 3rd cycle (9th, 10th or 11th year of schooling), intermediate education considers those who have at least upper secondary education or post-secondary non-tertiary education, while advanced education implies a tertiary education degree - either bachelor's, master's or doctoral (or equivalent) degree. As one might expect, the employment rate is higher, on average, for those who have achieved an advanced education level - either when considering young people (54%) or *old* people (63% and 68%). Figure 3.8 plots the employment and unemployment rates of young people, confirming that the group with

advanced education is the one better-off, although neither of the three educational-level groups fully recovered from the impacts of the financial crisis. When comparing to older people, Figure 3.9 makes clear that, whatever the educational level, the employment rate of the old is always higher than the one of the young, and it is particularly interesting to see that, even for those with tertiary education, the old employment rate is almost 40 p.p. higher than the youth employment rate in the end of 2021. This gap widened after the Portuguese sovereign debt crisis, which emphasises the concern of the increasing difficulty that young graduates find in entering the Portuguese labour market, especially in more qualified jobs and particularly in the context of economic crisis (Suleman & Figueiredo, 2020).

Table 3.2. Descriptive statistics (continued)

	Mean	Std. Dev.	Min.	Max.
By educational attainment				
Dependent variables				
Youth unemployment rate - Basic education	20.73	10.44	7.62	44.20
Youth employment rate - Basic education	34.44	13.85	8.67	53.91
Youth unemployment rate - Intermediate education	19.23	7.47	7.87	41.11
Youth employment rate - Intermediate education	30.39	4.02	21.08	39.65
Youth unemployment rate - Advanced education	22.44	8.68	4.94	44.95
Youth employment rate - Advanced education	53.55	12.07	32.58	77.14
Independent variables				
Old employment rate (55-SRA) - Basic education	42.98	3.69	35.17	49.35
Old employment rate (55-ERA) - Basic education	47.88	3.99	39.02	57.89
Old employment rate (55-SRA) - Intermediate education	50.83	7.52	34.64	66.51
Old employment rate (55-ERA) - Intermediate education	55.87	8.36	37.59	76.89
Old employment rate (55-SRA) - Advanced education	62.97	6.16	54.34	79.41
Old employment rate (55-ERA) - Advanced education	68.37	6.82	58.04	88.76

Figure 3.8. Youth employment and unemployment rates - By educational attainment

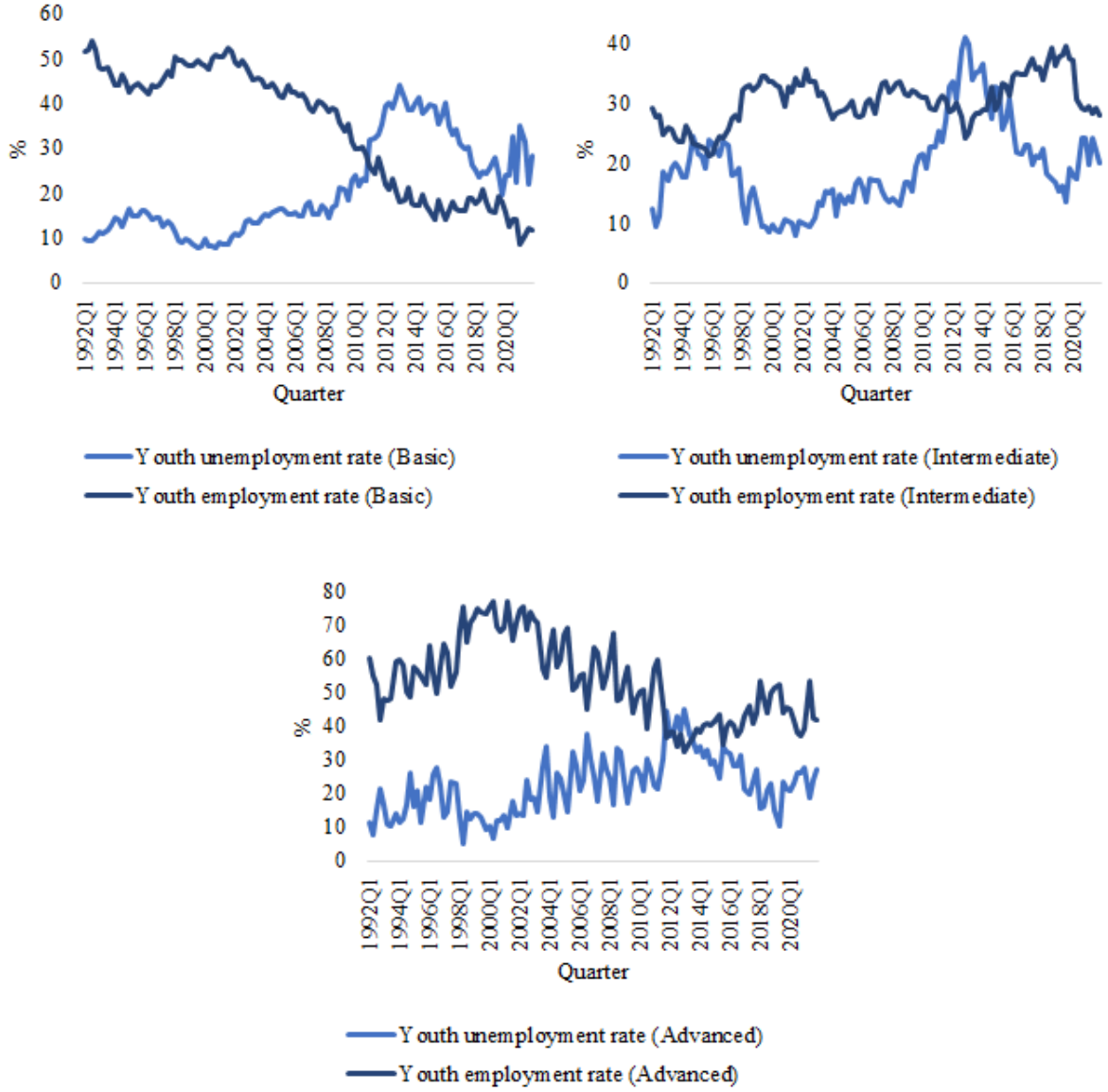
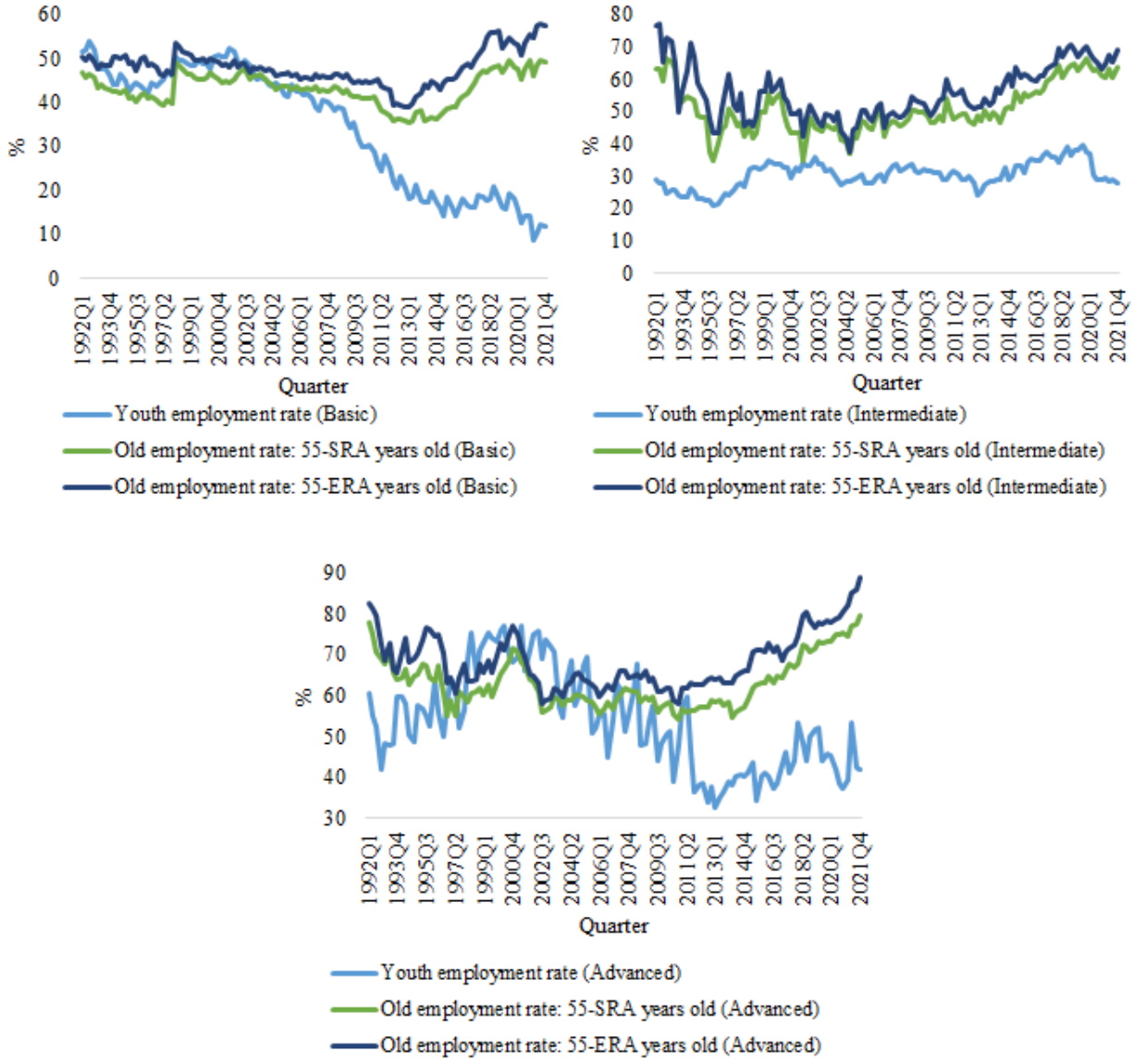


Figure 3.9. Youth *vs* old employment rates - By educational attainment



3.1.2 Control variables

Moving on to the model's potential control variables:

- For the *share of young individuals*, the survey's question of interest was "age". Along time, what is observed is a continuous decline in the share of young individuals - after 2004Q2, the share of young individuals in the country is always below its average value of 12.8%. Such evolution is in line with the inversion of the age pyramid registered in the country, as there are less and less young individuals, and more and more old individuals.
- Then, for the *variables that measure the concentration of employment in certain sectors*, the focus was the survey's question related to what was the main activity of the inquired individual's workplace, as defined by the 2 digits-NACE Rev.2 or NACE Rev.3 - depending on the survey's

year. Then, each 2 digits code was associated with the respective NACE section and, in its turn, each NACE section was associated with the secondary or tertiary sectors, in accordance with Regulation (EC) No. 1893/2006 and with Decree Law No. 381/2007. After that, the *share of self-employment* was also based on an INE's algorithm that defines each individual's employment status, which can be employed, self-employed, or employed by a family member without being paid - the category of interest here was the second one. As one may observe in Table 3.2, the Portuguese economy relies heavily on the tertiary sector - the share of employment in services has been increasing over time to reach 73% in 2021Q4, and youth employment is often concentrated in this sector. On the contrary, the share of employment in manufacturing - secondary sector - has been declining over time, passing from a peak of 26% in 1994Q3 to 16.4% in 2021Q4 - an historical minimum. On what regards self-employment, although it has been decreasing over the last decades to reach 14.8% in 2021Q4, there is a certain tendency for slight increases in periods of economic recession.

- Finally, the last potential control variable that draws on IE's data is the *share of young people with at least upper secondary education*, which resorted to the inquired individuals' answer on what was their highest level of completed education. From 1992Q1 until 2021Q4, the share of young people with at least upper secondary education registered a massive increase: from 32% to 91%. There are several reasons that support such evolution. The Portuguese Basic Law of the Educational System, established in 1986, was adjusted in 2009 and in 2015, so as to extend compulsory education to 12 years and to consecrate the universality of pre-school education for children from the age of 4. Additionally, Portugal's entry into the European Union also boosted the adoption of a set of strategies with an impact on improving education indicators. Moreover, the labour market is becoming more demanding, thus nudging young people to value education as a path to obtain more qualified and high-paid jobs. In theory, one would expected that more qualifications among the young would translate into higher levels of youth employment and, in the opposite way, into lower levels of youth unemployment.

Besides the control variables calculated based on IE's micro data, Table 3.1 also provides information about other potential control variables:

- Variables related with GDP were extracted from Eurostat. Regarding real *GDP per capita* - an indicator that divides a country's gross domestic product by its total population, typically used to assess the prosperity of a country -, it has been rising over time, although recently, in 2020, it registered the lowest value of the 20th century, as a result of the pandemic crisis. Although there might be various factors that lead to a higher GDP per capita - it can be, for instance, because technological progress is increasing the value added produced by an economy, with the

population level remaining stable, but it can also be the case that a country's population level is decreasing and the value added produced remains constant, thus indicating productivity gains -, literature unveils that higher GDP per capita positively impacts on employment, hence the choice of this variable to act as a control on the model. Maitah et al. (2015) found that, for Germany and Austria, a growth of 2% in GDP per capita is associated with a 1% increase in the employment rate.

- The *minimum wage (MW) variation* takes the MW in each year and calculates the change from the preceding quarter; since changes in MW usually happen at beginning of each year, its value will remain the same along the year and a change will only be observed at the first quarter of the following year, when the Government decides to change it. In Q2, Q3 and Q4 the variation is null. The rationale is that increases in MW may harm the employment of young people that want to enter the labour market, as employers are faced with an increase in costs for workers that they already employ. The impact of raises in MW on employment has been widely discussed, although the results are, to some extent, ambiguous. For overall employment, Alexandre et al. (2020) found that MW increases reduced employment growth. Regarding youth employment in particular, Pereira (2003) concluded that the 1987 MW increase reduced employment for people with 18-19 years old, but it increased employment of 20-25 years old people. For that same 1987 MW increase, Portugal and Cardoso (2006) argued that the net impact on youth employment was positive, since the lower proportion of hires was compensated by the even lower proportion of job separations. Later on, Centeno et al. (2014) studied MW increases in Portugal for the period 2002-2010 and a negative relationship between MW increases and the employment of minimum-wage earners was found, particularly for young workers.
- Lastly, Table 3.1 also provides the description of *old mortality rate*, on which we will focus our attention later on, when discussing the IV estimation approach. This variable will act like an instrumental variable in the model. As one may see in Table 3.2, it does not vary much over the time period under study: the maximum of 0.97% was reached in 1996, whilst the minimum of 0.65% refers to 2019, an evolution in accordance with the improvement in living standards and in health conditions. Since this is an yearly variable, in each quarter the variable takes the value of the respective year, which may not reflect its true evolution, but it was assumed to be a approximation to reality.

3.1.3 Correlation analysis

In order to analyse to which degree the participation of older people in the labour market - as a consequence of the legislated SRA - and the participation of younger people in the labour market are

correlated, one may also resort to Pearson's *r*, described by Pearson (1896) as the "product-moment correlation coefficient". Correlation is going to be analysed for the variables: youth unemployment rate (*yur*, henceforth); youth employment rate (*yer*, henceforth); old employment rate, with SRA as upper age limit (*oer_sra*, henceforth); old employment rate, with ERA as upper age limit (*oer_era*, henceforth) - here, the focus is on how young and old labour market variables relate with each other.

Considering that the correlation coefficient lays between -1 (perfect negative correlation) and +1 (perfect positive correlation), Figure 3.10 shows that the correlation between *yur* and both old employment rates is not very strong, but it is positive, which matches the hypothesis that, by keeping older workers in the labour market for longer, the legislated SRA is contributing to increased youth unemployment. When considering the *yer*, the correlation coefficient's sign is in line with that same hypothesis: a negative sign - and stronger than in the previous case - indicates that a higher old employment rate is associated with a lower youth employment rate. Proceeding to the disaggregated analysis, Figure 3.11 shows the correlation by gender. It is interesting to see that, for women, the correlation coefficient's sign is in accordance to what is registered for the aggregated case - and with even stronger coefficients -. but for men, the signs are the opposite. This suggests that the impact of the legislated SRA is negative for young women who want to enter the labour market, but not for young men. Going ahead, Figure 3.12 shows how the variables are correlated, considering different levels of educational attainment. Here, the conclusions are not that straightforward: for those with advanced education, both *yur* and *yer* are negatively correlated with old employment rates, thus not allowing to understand whether keeping older people in the labour market is being harmful for youth labour market outcomes; the same happens for those with intermediate education, but now the correlation coefficient is positive. Finally, for those with basic education, the correlation coefficient does not seem consistent with the crowd-out hypothesis, as old employment rates are negatively correlated with *yur* and positively correlated with *yer* - except when considering the pair *yer* and *oer_era*, where the correlation coefficient is negative, but very close to zero, thus indicating that there might not be a link between them. Last but not least, Figure 3.13 presents the results by region. Except for the regions Centro, RAA and RAM, the correlation between *yur* and old employment rates is always very close to zero. The correlation between *yer* and old employment rates is generally more significant and typically negative - except for RAM -, which is consistent with the crowd out hypothesis: more old people in the labour market is associated with less young people in the labour market.

Notwithstanding, Pearson (1986) assumed the normality, constant variance and linearity of the variables analysed. Therefore, the correlation measure given by Pearson's *r* may be influenced by non-normality, non-constant variances and/or non-linearity of the data. A common alternative to Pearson's *r* is the Spearman's rank correlation coefficient ρ. It is a non-parametric measure of corre-

lation developed by Spearman (1904) that assesses how well the relationship between two variables can be described using a monotonic function. Thus, the main difference between Pearson's r and Spearman's ρ is that the first assumes a linear relationship between the two variables, while the latter allows for a monotonic relationship where their (negative or positive) relationship does not necessarily need to assume a constant slope. As one may observe in Figures 3.14 to 3.17, although sometimes the correlation's strength changes, its sign is usually the same, thus confirming the evaluations above mentioned for the Pearson's r. However, correlation does not imply causation. In the next section, we will further explore the potential causation link between the variables.

3.2 Methodology

The quarterly data covers the period between the first quarter of 1992 and the last of 2021 (T=120). To investigate whether a higher participation of older people in the labour market - due to the imposed SRA - harms the participation of the young in the labour market or not, there are going to be used distinct econometric specifications. To sum up, one may identify three distinct "groups" of models under study:

- A set of four econometric specifications that aim to make a comparison with the results found in Gruber et al. (2010), estimated by OLS;
- A set of six econometric models that follow a careful analysis of the variables' statistical properties, estimated by OLS, with NW standard errors robust to serial correlation of the error term. These models are going to be repeated for an individual analysis by gender, by educational attainment and by region;
- A set of four econometric models, with old mortality rate as an instrument, estimated by two-stage least squares (2SLS).

The models estimated through the NW estimator were subject to a set of statistical tests: Augmented Dickey Fuller test with constant and trend; Augmented Engle-Granger test; Variance Inflation Factor; Regression Specification-Error test; and Breusch-Godfrey test. The statistical tests mentioned in this section were based on a 5 percent significance level. In order to conclude about the significance of the estimated models' coefficients, one should consider the following criteria: the coefficients marked with *, ** and *** are significant at the 10 percent, 5 percent and 1 percent levels, respectively. In each table, the standard errors are indicated in parentheses.

3.2.1 OLS estimation

In a first step, it is going to be conducted an OLS regression estimation of the direct relationship between the employment/unemployment of the young and the employment of the old. Similarly to the

set of studies on the volume edited by Gruber et al. (2010), the regressions are going to be estimated in levels (i.e., a contemporaneous relationship), with a three- year lag, with five-year difference and with five-year log difference. The volume studied 12 distinct countries, but Portugal was not one of them. The four econometric specifications are presented below:

$$Y_t = \beta_0 + \beta_1 Old_t + \delta X_t + \epsilon_t \tag{1}$$

$$Y_t = \beta_0 + \beta_1 Old_{t-12} + \delta X_t + \epsilon_t \tag{2}$$

$$Y_{t+20} - Y_t = \beta_0 + \beta_1 [Old_{t+20} - Old_t] + \delta [X_{t+20} - X_t] + \epsilon_{t+20} - \epsilon_t \tag{3}$$

$$lnY_{t+20} - lnY_t = \beta_0 + \beta_1 [lnOld_{t+20} - lnOld_t] + \delta [lnX_{t+20} - lnX_t] + \epsilon_{t+20} - \epsilon_t \tag{4}$$

where Y_t is the dependent variable and it can represent either the youth employment rate or the youth unemployment rate at quarter t. The key explanatory variable is the old employment rate at quarter t - Old_t -, which takes two different forms: the employment rate of people aged between 55 years and the SRA, and the employment rate of people aged between 55 years and the ERA. The vector X_t includes a set of time-varying control variables that might have causal effects on Y_t and, if omitted, the regression could result in a biased estimate of the causal effect of the key explanatory variables on Y_t. Following Gruber et al. (2010), this vector of control variables includes GDP per capita and the growth rate of GDP per capita. Similarly to some of the 12 countries under study - United States of America (USA), Japan, Spain, and Sweden -, the share of GDP coming from manufacturing will not be used here as a control variable, given its lack of availability for some of the periods under study. The growth rate of GDP per capita is calculated based on the same period of the previous year (year-on-year growth rate). The four specifications are estimated first with, and then without control variables. β_0, β_1 and δ are parameters, with β_1 being the parameter of interest, since it measures how the (un)employment of the young reacts to a 1% increase in the employment of the old. ϵ_t represents the error of the model.

3.2.2 Stationarity

Under time series analysis, the concept of stationarity is crucial. According to Wooldridge (2012), "a stationary time series process is one whose probability distributions are stable over time". In economic analysis, however, it is frequent to find non-stationary variables, ie. variables whose statistical properties (e.g. mean and variance) change over time. In the presence of non-stationary variables, one might incur in the estimation of a spurious regression (Enders, 2014). As documented by Granger and Newbold (1974), a spurious regression has a high R^2, but the usual significance tests on coeffi-

cients are invalid, thus making the relationship under study devoid of economic meaning.

Since the concept of stationarity is crucial to guarantee that no spurious relationship is being modeled, a second approach was to start from a base model and then apply the appropriate statistical tests to deal with stationarity of the four main variables under study. First, it was computed the Augmented Dickey Fuller (ADF) test with constant, and the null hypothesis was not rejected, thus pointing to the non-stationary of the time series (Table 3.3). Therefore, the second step was to compute the ADF test with constant and trend to confirm whether the time series were Difference-Stationary Processes (DSP) or Trend-Stationary Processes (TSP) - the null hypothesis was not rejected (Table 3.4); hence, one can conclude that the time series are DSP. The procedures and conclusions were similar to all the four variables - youth employment rate, youth unemployment rate and the two old employment rates. It was also performed an ADF test to the first differences of the four variables (Table 3.5), that pointed out to their stationarity - the variables are I(1) processes.

3.2.3 Cointegration

The next step was to test for cointegration. This test was done in pairs of two variables: youth unemployment with the two old employment rates, and youth employment with the two old employment rates. It was computed an Augmented Engle-Granger (AEG) test to the residuals of the correspondent model in levels and, in all the four cases, the null hypothesis was not rejected, meaning that there is no evidence of cointegration (Table 3.6). The following model was then estimated:

$$Y_{t+1} - Y_t = \beta_0 + \beta[Old_{t+1} - Old_t] + \delta[X_{t+1} - X_t] + \epsilon_{t+1} - \epsilon_t \tag{5}$$

where Y_t and Old_t are the same as already mentioned above. Taking into consideration that (un)employment series may be affected by other influences imperfectly controlled for by the adjustment variables used in specifications (1) to (4), there were additional control variables added to the vector X_t, similarly to the ones in Munnell and Wu (2013) and in Bertoni and Brunello (2020). The share of employment in services and the share of young individuals were ruled out by the Variance Inflation Factor (VIF), which identified them as a source of multicolinearity in the model. The final vector X_t includes GDP per capita, the homologous growth rate of GDP per capita and the percentage of young people who have completed at least upper secondary education. The only control variable that is not specified in first differences is the growth in GDP per capita, since it is already stationary.

As one may observe in Figure 3.18 - which confronts the youth unemployment rate with both old employment rates -, there seems to be a structural break after 2013Q1. When considering time series data, longer time spans have a higher likelihood of being influenced by events that change the parameters of the model (Ditzen et al. 2021), like technology shocks or economic recessions. Is there

any economic reasoning behind such structural break? An historical analysis shows that in Portugal, since 1980, the most extended recession arises in the context of the sovereign debt crisis - after a brief period of economic growth between 2009Q1 and 2010Q3, with real GDP per capita growing 2.7%, the following ten quarters mark a deep economic recession that endend, precisely, in 2013Q1 - with real GDP per capita falling by 6.9% in relation to the previous peak (FFMS, n.d.). Also, Rua (2017) identifies April 2013 as the end of that same recession - very close to 2013Q1 -, by resorting to the monthly coincident indicator for the Portuguese economic activity - a composite indicator that considers not only real GDP but also other relevant economic variables available in a monthly basis, thus making it a particularly suitable indicator for dating business cycles, as the author argues.

In order to test for the structural break in 2013Q1, it was used a Stata command developed by Ditzen et al. (2021) that allows to test for a known structural break - in this case, we want to test for no break against the alternative of a break in 2013Q1. The null hypothesis that there is no break was rejected and, therefore, there were estimated distinct regressions when the youth unemployment rate is the dependent variable: before and after 2013Q1.

3.2.4 Additional statistical tests

After arriving to the final specifications for each pair of dependent and independent variables, two additional statistical tests were computed:

- The regression specification-error test (RESET), which aims to "test for the presence of specification errors" (Ramsey, 1969), ie. to detect omitted variables and potential erroneous functional form of the linear regression model. When applying the RESET test, the null hypothesis of no omitted variables was not rejected, which points out to the adequacy of the model's functional form (Table 3.7). The only two exceptions were the models where the youth unemployment rate is being explained by the two old employment rates, after the structural break of 2013Q1. In these cases, there were added the squared terms of GDP per capita and growth rate of GDP per capita as regressors; the RESET test was then repeated, now pointing out to an adequate functional form.
- The Breusch-Godfrey (BG) test, developed by Breusch (1978) and Godfrey (1978), aims at testing if the errors of linear models are auto correlated. Comparing to the DurbinWatson statistic developed by Durbin and Watson (1950) to test for first-order serial correlation, the BG test goes beyond it, as it allows to test serial correlation up to p lags. Moreover, the BG test does not require all regressors to be strictly exogenous, which is particularly important in dynamic equations where the lagged dependent variable appears as a regressor (Breusch, 1978). In the presence of quarterly data, one may want to test seasonal forms of serial correlation (Wooldridge,

2012); therefore, it was computed the BG test up to p=4. The results of the BG test pointed out to the existence of errors' serial correlation (Table 3.8). Consequently, the model was then estimated with the NW estimator, which assumes an error structure that is heteroskedastic and possibly autocorrelated up to p lags.

The NW robust estimator was used not only for the aggregated model, but it was also applied to the analysis by gender, by educational attainment and by region. The final models are summarized in Table 3.9. The only exception in Table 3.9 is for the regressions by educational attainment, where having the percentage of young people who have completed at least upper secondary education as a control variable is devoid of economic meaning; instead, it was used the share of employment in services, in line with Munnell and Wu (2013), and Bertoni and Brunello (2020). The goal is to see whether the results at the national level change when considering different sub-samples of the population.

Table 3.9. Effects of old employment on young labour market outcomes - Models

Model	Time period	Dependent variable	Independent variable(s)	Control variables
i)	1996Q1-2013Q1	Youth unemployment rate	SRA	GDP per capita, growth rate of GDP per capita, % of young people who have completed at least upper secondary education
ii) - **(a)**	2013Q2-2021Q4			
iii)	1996Q1-2013Q1		ERA	
iv) - **(a)**	2013Q2-2021Q4			
v)	1996Q1-2021Q4	Youth employment rate	SRA	
vi)			ERA	

Note 1: All variables are in first differences, except for the growth rate in GDP per capita.
Note 2: Here, SRA and ERA make reference to the old employment rates that they respectively represent.
Note 3: The models identified with (a) have the squared GDP per capita and growth rate of GDP per capita as controls.

3.2.5 IV estimation

Lastly, because of endogeneity concerns, it was adopted an IV estimation approach. As there might be unobserved factors that have simultaneous impacts on the labour outcomes of both age groups, then OLS estimates may be biased. Therefore, one must find a variable IV_A that a) is exogenous - $E(\epsilon|IV_A) = 0$ and, thus, has no direct impact on the (un)employment of younger people, and b) is correlated with the employment of older people - $cov(IV_A, Old) \neq 0$. It was chosen the mortality rate of old people as an instrumental variable. This choice is similar to the one in Munnell and Wu (2013), the only difference being that the authors adopted a male-only approach "for larger variation across

state over time"; nevertheless, we found more appropriate to consider both genders combined, as the employment rates used also combine employees of both genders.

On what regards requirement a), since the number of instrumental variables and (potentially) endogenous variables is the same (old mortality rate and old employment rate, respectively), it is not possible to test whether old mortality rate is endogenous or not. However, one may provide theoretical arguments. It does not seem plausible that better or poorer health status of older people exert impact on the performance of young people in the labour market and, to the best of the author's knowledge, there is no evidence in literature that links both phenomenons. Moreover, Stevens et al. (2015) found that older people mortality rates and the work status of younger workers are independent. In addition, it was estimated a reduced-form model with the old mortality rate as an independent variable and the results showed that there is no statistically significant relationship between old mortality rate and labour supply of the young. The definition of old mortality rate is in Table 3.1. Regarding requirement b), literature provides evidence of a strong link between health and working capacity, as ill health is associated with early retirement (Mein et al., 2000; Harkonmäki et al., 2006). The employment of older people is found to be conditioned on the health status: Clarke et al. (2012) investigated whether health was related to expectations to continue working beyond age 62 and concluded that self-reported chronic health issues were associated with a lower probability of working full time after 62; as highlighted in Oksanen and Virtanen (2012), such conclusion is in line with evidence showing that poor health is a strong predictor of intentions to retire (Harkonmäki et al., 2006) and of a lower expected retirement age (Sargent-Cox et al., 2012). Although financial insecurity often keeps employees longer in employment (Mein et al., 2000), McGarry (2004) argues that "changes in retirement expectations are driven to a much greater degree by changes in health than by changes in income or wealth", with early exit from the labour market being strongly associated with poor health.

As health shocks often lead to early retirement (Hurd & Rohwedder, 2008), with the consequent impact on the employment rate of older people, which variable may be used to reflect health status? The own-age group mortality rate has been widely identified as strongly associated with one's own group health status and, therefore, to own-group employment (Munnell & Wu, 2013). Moreover, Stevens et al. (2015) found that "own group mortality is, if anything, negatively correlated with one's own group employment rate". In addition to the evidence found in literature, one may estimate the models in Table 3.9, but substituting the dependent variable with the old employment rate, and using the old mortality rate as a regressor. The estimation yields a statistically significant relationship between both variables.

In order to estimate the model following an IV approach, it was used the *ivregress* package in Stata - which fits linear equations with endogenous regressors - and estimation via 2SLS. As with OLS, 2SLS

estimation also raises concerns with serial correlation and heteroskedasticity (Wooldridge, 2012). In order to address such concerns, *ivregress* was used with the option for computing heteroskedasticity- and autocorrelation-consistent (HAC) standard errors and with the NW optimal lag-selection algorithm for lags' selection. Due to data availability issues (regarding the instrumental variable), the model is going to be estimated for the period 1998Q2-2020Q4. Here, contrarily to subsections 4.2 and 4.3, no structural break was applied, as the *xtbreak* command did not reject the null hypothesis of no break at 2013Q1.

4 Results

If delayed retirement of older people proved to be harmful for the employment of younger people, one should expect the effect of old employment on youth employment to be negative, while on youth unemployment it should be positive. Being true, this would be consistent with the view that keeping older workers in the labour market for longer crowds out young people from the labour market; the two age groups would behave as substitutes, rather than complements. In the next paragraphs, it will be analysed if such relationship holds.

4.1 OLS estimation

Starting with Table 4.1, one may observe that the old employment rate plays a more important role when explaining the youth employment rate than when explaining the youth unemployment rate - regardless of being calculated with the SRA or with the ERA. So, let's start by analysing this relationship. When in levels - with or without controls - and when the coefficients are statistically significant, the estimated regressions establish a negative relationship between the employment rates of the old and of the young: an increase in the employment of older people, *ceteris paribus*, leads the employment of the young to decrease, thus supporting the crowd-out hypothesis. These results are in line with countries like the USA and Sweden, both in terms of sign and magnitude.

However, the above mentioned results may be under the influence of a spurious relationship. Indeed, when specified in differences and when statistically significant, the coefficients' sign is positive, thus suggesting that the opposite: that the employment of both age groups are positively related - an increase in the employment of the old leads to an increase in the employment of the young. In the most significant case, a 1 p.p. increase in the old employment rate (SRA as upper age limit) leads the youth employment rate to increase by 0.3 p.p., *ceteris paribus*.

When comparing to other countries, specifications in differences generally return similar results to Portugal, both in sign and magnitude. In Belgium (Jousten et al., 2010), Japan (Oshio et al., 2010), the Netherlands (Kapteyn et al., 2010) and United Kingdom (UK) (Banks et al., 2010), the impact of old employment on youth employment varies between 0.29 and 0.61 p.p.. Yet, there are also cases where the sign goes in the opposite way - in Germany (Börsch-Supan & Schnabel, 2010), the relationship is negative -, and cases where the relationship is not significant at all - like Canada (Baker et al., 2010).

On what regards the impact of older employment in the unemployment of younger people, results also differ according to the specification. An increase of 1 p.p. in *oer_sra* leads youth unemployment to increase by 0.54 p.p., after three years. When in differences, an increase of 1 p.p. in *oer_era* leads youth unemployment to increase by 0.28 p.p.. However, there is also the case where the impact is negative, varying between -0.6 and -0.4 p.p.. Thus, concerning the impact on the youth unemployment

rate, it is not clear whether the relationship is consistent with the crowd-out hypothesis or not. Except for Belgium (Jousten et al., 2010)), Japan (Oshio et al., 2010) and Sweden (Palme & Svensson, 2010) - where it is found a positive relationship between both variables, thus consistent with the crowd-out hypothesis -, in other countries, the impact of old employment on youth unemployment is negative, although the sensitivity of youth unemployment's response varies across countries: when in levels, the most sensitive country is Italy (-2.7 p.p.) (Brugiavini & Peracchi, 2010), and the less sensitive is the UK (-0.2 p.p.) (Banks et al., 2010).

Table 4.1. Estimated effects of old employment on young labour market outcomes - comparison with Gruber et al. (2010)

	SRA as key explanatory variable	
	Youth unemployment rate	Youth employment rate
	Without controls	
Levels	0.08	-0.54***
3-year lag	0.54**	-0.92***
5-year difference	0.10	0.21*
5-year log difference	-0.13	0.30*
	With controls	
Levels	-0.60***	-0.02
3-year lag	0.18	-0.53**
5-year difference	0.09	0.16*
5-year log difference	-	-
	ERA as key explanatory variable	
	Youth unemployment rate	Youth employment rate
	Without controls	
Levels	0.22	-0.64***
3-year lag	0.24	-0.73***
5-year difference	0.14	-0.06
5-year log difference	-0.41**	0.99***
	With controls	
Levels	-0.05	-0.42***
3-year lag	-0.04	-0.40**
5-year difference	0.28**	0.07
5-year log difference	-	-

The results' sensitivity to the model's specification resembles what was found in the volume edited by Gruber et al. (2010) for some countries. For instance, Börsch-Supan and Schnabel (2010) state that, for Germany, "results are very sensitive to the specification chosen"; Salem et al. (2010) conclude that, for France, after including controls, coefficients of senior labour force participation tend to become insignificant; for the Netherlands, adding controls generally turns coefficients insignificant and to switch sign (Kapteyn et al., 2010).

In Table 4.1, there are cases identified with a hyphen, representing models for which Stata is not able to provide an estimate. This happens because there are values in differences that are negative, and it is not possible to calculate the logarithm of a negative value. Thus, the amount of missing values do not allow the estimation.

4.2 NW robust estimation - Aggregated model

Since the previous regressions provide ambiguous results, we will now move on to the analysis of Table 4.2. As already seen in the previous section, this model's specification results from a series of statistical tests that aim to guarantee the quality and interpretability of results. As mentioned in sub-subsection 3.2.4., the results in Table 4.2 include controls and are estimated in differences, thus, when confronting to Table 4.1, they should be compared with the analogous estimations - the choice for estimating the model with 1-year differences, instead of 5-year differences as in Table 4.1, is justified in sub-subsection 3.2.2., when explaining that the variables are I(1) processes.

Moving on to the analysis of the results, one may conclude that the impact on the youth employment rate of a 1 p.p. increase in the old employment rate is always positive. The impact of *oer_sra*, however, is more significant and of slightly higher magnitude: +0.36 p.p., comparing with +0.23 p.p.. These results are in line with the models specified in differences previously seen in Table 4.1. On what regards the impact on the youth unemployment rate, only after 2013Q1 the coefficients are significant, and only for the specification with *oer_sra*: after 2013Q1, a 1 p.p. increase in *oer_sra* leads to a 0.75 p.p. decrease in the youth unemployment rate, *ceteris paribus*. A possible explanation for this structural break might be two-folded: on the one hand, after reaching a peak in 2013, the youth unemployment rate started a downward trajectory as the economic crisis began to soothe; on the other hand, the old employment rate, which had been relatively stable over the past years, started an upward trend after 2013, which might be related not only with the period of economic growth after the crisis, but also with the 2012 legislative measure of suspending anticipated reforms, thus keeping older workers in employment for longer than if workers had the possibility to retire earlier. This suspension was partially withdrawn in 2015, but even so the old employment rate kept increasing until the present.

These results seem to indicate that older and younger workers act as complements in the labour market. Indeed, Table 4.2 does not deny the existence of a relationship between both age groups in the labour market, although its direction is the opposite of the one suggested by the correlation analysis in Figures 3.10 and 3.14, thus validating the maxim "correlation does not mean causation".

However, as argued by Bertoni and Brunello (2020), one reason why "empirical research on the causal effects of changes in retirement eligibility age on youth employment and unemployment is

relatively scarce and with contrasting results" relies on the complexity of identifying the underlying causal effects, as policies changing the statutory retirement age affect entire countries, but local labour markets have their own specificities - namely, different local age structures. The authors address this issue by identifying local labour market either with NUTS III or NUTS II territorial division.

Table 4.2. Estimated effects of old employment on young labour market outcomes - Aggregated case

	Youth unemployment rate		**Youth employment rate**
	Before 2013Q1	After 2013Q1	
SRA as key explanatory variable	0.08	-0.75**	0.36**
	(0.12)	(0.33)	(0.14)
ERA as key explanatory variable	0.04	0.02	0.23*
	(0.11)	(0.36)	(0.13)

4.3 NW robust estimation - Different samples

With this in mind, this study combines an analysis for the labour market as a whole, with more detailed analysis not only by region, but also by gender and by educational attainment.

In order to see if results change when differentiating according to gender, the model was re-estimated, but now both left and right-hand sides of the model are divided by gender. The goal is to explore whether both genders have been differently influenced by the participation of the old in the labour market. As presented in Table 4.3, these new regressions give similar results to those of Table 4.2. The magnitudes of the coefficients on employment of older people are generally lower, and significance fails in some cases. However, for both men and women, the results show no evidence of crowd-out.

Table 4.3. Estimated effects of old employment on young labour market outcomes - By gender

	Youth unemployment rate		**Youth employment rate**
	Before 2013Q1	After 2013Q1	
Male			
SRA as key explanatory variable	-0.13*	-0.12	0.25***
	(0.07)	(0.26)	(0.09)
ERA as key explanatory variable	-0.12	0.32	0.20**
	(0.08)	(0.39)	(0.11)
Female			
SRA as key explanatory variable	0.04	-0.78*	0.20
	(0.21)	(0.31)	(0.12)
ERA as key explanatory variable	0.06	-0.58*	0.19*
	(0.22)	(0.32)	(0.10)

As one may observe in Table 4.3, after 2013Q1, the female youth unemployment rate is more sensitive to increases in old employment, when comparing to the case of male. There was no pension reform aimed at discriminating men and women in the labour market that may justify such difference. Gruber and Milligan (2010), when studying the USA, also found that in male-only estimations, "statistical significance fails in some cases", when comparing to men and women pooled together. The authors provide as possible explanation the "secular trend increase in female employment" over the period being studied (1962-2007). In Portugal, when the old employment rate increases, the youth employment rate also increases, while the youth unemployment rate decreases, as periods of economic expansion benefit both age groups. Adding to this, Table 4.3 suggests that the negative effect on the youth unemployment rate is mainly due to the evolution of female unemployment. Therefore, the general case estimates seem to be tainted by the evolution of female labour market outcomes, a reality that may be grounded on the increasing attention given to the gender gap in the labour market.

Over the last years, the European Commission has been raising awareness about the need to promote equal opportunities for men and women in the access to the labour market. The Strategy for Equality between Women and Men (2010-2015) and the Europe 2020 Strategy provide guidelines to promote female participation in the labour market, namely through policies that reduce women' disproportionate responsibilities of parenthood, that promote female entrepreneurship and, also, that fight segregation in the labour market, as women and men still tend to work in different sectors/jobs. The Portuguese government aligned its national strategy with the communal one by promoting policies that reduced gender inequalities in the labour market, for instance, through its National Plans for Gender Equality, Citizenship and Non-discrimination defined by the RCM No. 5/2011 and No. 103/2013. Among others, these Plans integrated measures that promoted: the implementation of equality plans within private sector companies; female entrepreneurship - through incentives for companies' creation and through the access to more favorable credit lines; the use of parental leave by men; female employment in the transports' sector, which is traditionally held by men.

Moving forward, Table 4.4 differentiates *yur*, *yer*, *old_sra* and *old_era* by people' completed level of education. Are older workers retaining young people from entering the labour market, for particular levels of education? The answer seems to be negative. When comparing to the aggregate analysis, many coefficients lose significance, particularly for individuals with intermediate education. For people with basic and advanced education, however, a higher old employment rate seems to be associated with a lower youth unemployment rate after the 2010-2013 recession. The magnitude of the coefficient is particularly significant for those with only a basic level of education: an increase of 1 p.p. in *oer_sra* leads to a 2.2 p.p. decrease in the youth unemployment rate. Regarding the impact on the youth employment rate, coefficients are positive and significant only at the basic education level.

Table 4.4. Estimated effects of old employment on young labour market outcomes - By educational attainment

	Youth unemployment rate		Youth employment rate
	Before 2013Q1	After 2013Q1	
Basic			
SRA as key explanatory variable	-0.13	-2.2*	0.33**
	(0.18)	(1.22)	(0.16)
ERA as key explanatory variable	-0.04	-0.86	0.20**
	(0.18)	(0.59)	(0.11)
Intermediate			
SRA as key explanatory variable	0.05	-0.23	0.02
	(0.07)	(0.29)	(0.05)
ERA as key explanatory variable	0.00	-0.12	0.03
	(0.05)	(0.23)	(0.04)
Advanced			
SRA as key explanatory variable	-0.38	-1.02**	0.27
	(0.28)	(0.39)	(0.27)
ERA as key explanatory variable	-0.34	-0.44	0.28
	(0.25)	(0.48)	(0.22)

For the case of people with advanced education, the reason why an higher old employment rate leads to a lower youth unemployment rate may lay on education spillover effects: by developing new ideas and innovative production processes, highly educated workers may spur labour demand in the areas in which they work in (Winters, 2018). For the case of people with basic education, there not seems to be a link between a higher old employment rate and higher(lower) youth employment(unemployment) rates. Nevertheless, in both cases, the fact that the reduction in the youth unemployment rate is only significant in the period after 2013 may be under the influence of governmental programs targeted to fight youth unemployment in the aftermath of the crisis. Especially after the 2008 global economic crisis, there was an increase in the number of youth-oriented active labour market policies in the EU, and Portugal was no exception (Marques et al., 2021). In Portugal, policies focused on providing higher education graduates and non-graduates with a higher chance of integrating the labour market, namely through requalification measures, apprenticeships and incentives to employers such as wage subsidies (Marques & Videira, 2021). At the same time, there were also measures aimed at tackling early school leaving (ESL) - one of the main indicators of the performance of educational systems at the European level, since early school leavers, by not completing secondary education, face a more vulnerable situation in the access to the labour market. Therefore, when considering the unemployment rate of young people with basic education, its reduction may

reflect a lower numerator, as the number of young people with only basic education started decreasing, given the implementation of ESL policies like the extension of compulsory schooling from 9 to 12 years in 2009.

The last differentiation is based on people's place of residence. Although people may live in one city and work in other one, NUTS II level regions comprise a wide range of neighbouring territories, thus being very likely that the region of residence is the same as the region of the workplace. The results in Table 4.5 are consistent with the aggregate analysis on what concerns the impact on the youth employment rate: when significant, the impact of a 1 p.p. increase in the old employment rate always leads the youth employment rate to increase, although the magnitude changes depending on the region considered and on the upper age limit of the old employment rate. The region that stands out is Algarve, where a 1 p.p. increase in the old employment rate leads to a 0.92 p.p. or 0.69 p.p. increase in the youth employment rate, depending on whether we use *oer_sra* or *oer_era* as a regressor, respectively. Moreover, Algarve is also the region where the old employment rate has a stronger negative effect on the youth unemployment rate - and, as a matter of fact, the only one. Contradicting the national pattern is the region Centro, where *oer_sra*'s coefficient on the youth unemployment rate is positive, thus being consistent with the crowd-out hypothesis: increased participation of older people in the labour market is preventing young people from entering the labour market. However, the conclusion is not that straightforward, since, for this region, the impact of *oer_sra* on the youth employment rate is positive, thus not consistent with the crowd-out hypothesis. Nevertheless, the positive impact on *yur* is more statistically significant and of a higher magnitude than the positive impact on *yer*, thus suggesting that the latter may be overshadowed by the former.

Table 4.5. Estimated effects of old employment on young labour market outcomes - By region

	Youth unemployment rate		Youth employment rate
	Before 2013Q1	After 2013Q1	
Norte			
SRA as key explanatory variable	-0.21	-0.32	0.28***
	(0.15)	(0.58)	(0.10)
ERA as key explanatory variable	-0.20	-0.11	0.24***
	(0.12)	(0.30)	(0.08)
Centro			
SRA as key explanatory variable	0.09	1.34***	0.14**
	(0.14)	(0.43)	(0.06)
ERA as key explanatory variable	0.11	0.42	0.09
	(0.13)	(0.44)	(0.08)
AML			
SRA as key explanatory variable	0.14	-0.55	0.12
	(0.22)	(0.34)	(0.11)
ERA as key explanatory variable	0.41	0.08	-0.05
	(0.20)	(0.39)	(0.10)
Alentejo			
SRA as key explanatory variable	-0.37	-0.65	0.02
	(0.29)	(0.58)	(0.13)
ERA as key explanatory variable	-0.44**	-0.59	0.14*
	(0.18)	(0.69)	(0.08)
Algarve			
SRA as key explanatory variable	-0.20	-2.30***	0.92***
	(0.23)	(0.49)	(0.27)
ERA as key explanatory variable	-0.11	-1.83***	0.69***
	(0.27)	(0.40)	(0.24)
RAA			
SRA as key explanatory variable	-0.07	-0.53	0.07
	(0.14)	(0.41)	(0.10)
ERA as key explanatory variable	-0.01	-0.04	-0.03
	(0.11)	(0.38)	(0.10)
RAM			
SRA as key explanatory variable	-0.38	-0.50	0.11
	(0.26)	(0.38)	(0.09)
ERA as key explanatory variable	-0.27	-0.03	0.16**
	(0.19)	(0.32)	(0.07)

As seen before, the youth employment rate is positively related with the old employment rate, which is in accordance with the theory that, when economic conditions improve, more employment is created both for old and young people, that act as complements in the labour market. In Table 4.5,

this relationship proves to be stronger in the regions Norte and Algarve. This might be related to the fact that, on the one hand, Norte is one of the most dynamic regions of the country in terms of investment, as a result of structural factors such as quality of life, social stability, infrastructure, labour skills and labour costs (Ernst & Young, 2019). It has been identified as the most attractive region in Portugal for foreign direct investment (FDI), being the leading Portuguese region when it comes to FDI job creation (Ernst & Young, 2019). On the other hand, Algarve's labour market dynamics is typically different from the one of the other Portuguese regions, which may explain the sensibility of youth employment and youth unemployment patent in the estimates of Table 4.5. Algarve is a peripheral region in the south of Portugal that has its economic prosperity mainly dependent on the tourism sector (Pinto & Guerreiro, 2010) and, especially during summer months, there is a massive influx of tourists, which translates into an acceleration in tourism-related businesses, which in its turn increases recruitment needs and, as a consequence, there is a momentary employment recovery that is followed by employment reductions in the following months. The reason why the youth unemployment decreases between 1.83 and 2.3 p.p. when the old employment rate increases by 1 p.p. may lay behind the seasonal nature of unemployment in Algarve: the increase in labour demand during summer is partially tackled by temporarily hiring young workers. This causes an artificial decrease in youth unemployment, since young workers are sometimes being subject to precarious forms of attachment to the labour market. As a matter of fact, in Portugal, the prevalence of temporary employment is among the highest in the EU, with an emphasis on young people (Valadas, 2021). In 2021, 54% of young workers (aged 15-24) were in temporary employment contracts in Portugal, a proportion that compares with 6% for those aged 55-64 (Eurostat, n.d.).

4.4 IV estimation

We now turn to the last exercise that relates the old employment rate and youth labour market outcomes, by instrumenting the first with the old mortality rate, thus resulting in a specification less prone to endogeneity issues. The results in Table 4.6 are for a model specified in first differences, with control variables, and they are consistent with the ones in Table 4.2 and the ones in Table 4.1 (for the cases when variables are specified in differences). All coefficients are statistically significant at the 1% level. When the upper age limit for the old employment is the SRA, a 1 p.p. increase in the old employment rate has a negative impact on *yur* and a positive impact on *yer*: *ceteris paribus*, -1.03 p.p. and +0.63 p.p., respectively. The sign is the same when the ERA is used as upper age limit, although the coefficients' magnitude is slightly lower. Once again, the legislated SRA - as measured by the older people still in the labour market because they have an age up to the SRA -, does not seem to be reducing youth employment, neither increasing youth unemployment.

Table 4.6. Estimated effects of old employment on young labour market outcomes - IV estimation

	Youth unemployment rate	Youth employment rate
SRA as key explanatory variable	-1.03***	0.63***
	(0.30)	(0.13)
ERA as key explanatory variable	-0.85***	0.52***
	(0.26)	(0.08)

How do these results compare to other countries already studied? For the twelve countries studied in the volume edited by Gruber et al. (2010) - where the instrumental variable is a measure of the incentives faced by older people to leave the labour force -, evidence of crowd-out was only found for two countries (Spain and the USA), and only at a very weak level - although coefficients are statistically significant, they are very close to zero and provide different conclusions depending on the model's specification. For Spain, Boldrin et al. (2010) found that an increase in incentives to retire would lead the youth employment rate to increase between 0.002 and 0.011 p.p.. Also, the youth unemployment rate would decrease between 0.002 and 0.012 p.p.. These results are consistent with crowd-out. For the USA, Gruber and Milligan (2010) reached estimates of the same sign and similar magnitude.

However, for other countries, the results are the opposite. Börsch-Supan and Schnabel (2010) concluded that, in Germany, "stronger incentives to retire early reduce employment of the younger age groups and increase their unemployment". For Canada, Baker et al. (2010) reach the same conclusion. As in Table 4.6, these conclusions do not support the crowd-out theory.

More recently, Bertoni and Brunello (2020) found that, in Italy, delayed retirement eligibility contributed to higher youth unemployment. Between 2005 and 2016, for each 1.000 additional senior workers, 46 very young individuals (aged 16-24) will be left outside the labour market. Even for a longer period from 1996 to 2016 - a period that is not dominated by the 2008 Great Recession -, the impact is still negative for the employment of very young individuals, although smaller, thus suggesting that "the employment costs of pension reforms rising retirement eligibility age may be lower when these reforms are introduced in a growing economy" (Bertoni & Brunello, 2020).

Even though there is a tendency to compare Italy and Portugal in terms of economic structure, there are factors that may explain the opposite conclusions found for both countries. Contributing to these factors are, first of all, differences in the econometric specifications used - the control variables are not the same, nor the unit in which the variables are measured, nor the IV specification. Additionally, the fact that Italy passed through several pension reforms that increased the SRA of employees in the private sector from 52 years-old in 1996, to above 65 years-old for women and above 66 years-old for men in 2016, thus providing wider variation in Italian data - Portugal already had from a relatively high SRA of 62 years-old for women and 65 years-old for men in 1992.

5 Conclusions

The sustainability of Social Security's budget and the high levels of youth unemployment are two structural issues for matters of public policy in Portugal. Among other measures, the increase in the statutory retirement age has been one of the solutions found by the Portuguese government to promote Social Security's financial equilibrium (Barradas & Lagoa, 2019). Indeed, social transfers - namely old-age pensions -, have been playing a key role in tackling the economic vulnerability of older people: this age group has the highest at-risk-of-poverty rate before social transfers (almost 90%), which decreases approximately 60 p.p. after social transfers. However, after social transfers, young people take the first place in the podium of the highest at-risk-of-poverty rates.

Therefore, the key question in this study is whether this public policy of high and increasing statutory retirement ages, although contributing to pay the pensions of the older, is not harming the entry of young people in the labour market. Given the link between unemployment and poverty - evidence shows that unemployment increases the risk of poverty and contributes to inequality, debilitating not only unemployed people themselves, but also their families (Saunders, 2002) -, it is crucial to guarantee that young people are not being left aside the labour market as a secondary effect of another public policy.

With such aim, the youth unemployment and employment rates were modelled as a function of the old employment rate, in order to understand how the latter affects the evolution of the former. Comparing to the existing literature, the main novelty here was to consider the employment of older people who have *at most* the SRA in each year, thus capturing how this policy have been affecting the age-composition of the labour market. To the best of the author's knowledge, Bertoni and Brunello (2020) are the only who make such distinction. Additionally, it is the first one to provide results by region.

Regardless of the estimation method used, when significant, estimates consistently point to the same conclusion: when the old employment rate increases, the youth employment increases and the youth unemployment rate decreases. *Ceteris paribus*, a 1 p.p. increase in the old employment rate leads the youth employment rate to increase between 0.23 and 0.63 p.p., and the youth unemployment rate to decrease between 0.75 and 1.03 p.p., depending on the econometric specification. These results are not consistent with the theory that, by increasing the SRA, older people will remain in the labour market for longer and take away job opportunities for the young. Instead, these results are in line with the criticisms made at the light of the lump of labour fallacy. Yet, it is interesting to note that, although the positive association between the employment rates of both age groups is significant for the whole time span, the negative effect on the youth unemployment rate is only verified after the end of the 2010-2013 recession, thus indicating a structural change on how these variables relate and

evolve over time. There is no evidence that a specific pension reform caused this series break; instead, the estimates of the general case seem to reflect specificities of the different samples - for instance, the governmental programs targeted to fight youth unemployment in the aftermath of the crisis, and the increasing awareness of the gender gap in the labour market that prompted policies aimed at enhancing female employment.

When significant, estimates by gender, by educational attainment and by region showed adherence to the aggregate analysis. The only exception was the region Centro, where the relationship between the old and the young in the labour market after the 2010-2013 recession is consistent with the crowd-out hypothesis. Nevertheless, one should bear in mind that these micro analyses may not follow the national case. Therefore, relevant future research would be to study specific econometric specifications for each region, namely by including control variables that are important for the behaviour of local labour markets. Munnell and Wu (2013), when studying if delayed retirement leads to higher unemployment among the young in the USA, resort to state-level regressions. Another suggestion for future research is to look for alternative instrumental variables - although successfully meeting the requirements to be considered as an instrument, the old mortality rate presents only little variation over time and it is computed on an yearly basis. Additionally, it would be interesting to further investigate how is the increase in youth employment composed on what regards the type of contract arrangements - is the increase in youth employment based on precariousness? -, since such dimension is not being considered here.

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Appendix A - Tables

Table 3.3. ADF test with constant

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. dfuller yur

Dickey-Fuller test for unit root                   Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -1.387            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5883

. dfuller yer

Dickey-Fuller test for unit root                   Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -1.092            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7181

. dfuller sra

Dickey-Fuller test for unit root                   Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)             0.406            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9817

. dfuller era

Dickey-Fuller test for unit root                   Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)             0.987            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9941
```

Table 3.4. ADF test with constant and trend

```
. dfuller yur, trend

Dickey-Fuller test for unit root                    Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -1.411           -4.034            -3.447           -3.147
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8577

. dfuller yer, trend

Dickey-Fuller test for unit root                    Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -1.786           -4.034            -3.447           -3.147
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7113

. dfuller sra, trend

Dickey-Fuller test for unit root                    Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -1.730           -4.034            -3.447           -3.147
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7376

. dfuller era, trend

Dickey-Fuller test for unit root                    Number of obs   =       119

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -1.050           -4.034            -3.447           -3.147
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9370
```

Table 3.5. ADF test with constant - variables in first differences

```
. dfuller d.yur

Dickey-Fuller test for unit root                   Number of obs   =       118

                         ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -10.995            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller d.yer

Dickey-Fuller test for unit root                   Number of obs   =       118

                         ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -11.155            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller d.sra

Dickey-Fuller test for unit root                   Number of obs   =       118

                         ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -11.924            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller d.era

Dickey-Fuller test for unit root                   Number of obs   =       118

                         ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -11.516            -3.504            -2.889           -2.579
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

Table 3.6. Augmented Engle-Granger test

```
. egranger yur sra

Engle-Granger test for cointegration                 N (1st step)  =       120
                                                     N (test)      =       119
------------------------------------------------------------------------------
                Test         1% Critical       5% Critical      10% Critical
              Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)           -1.439            -3.990            -3.388            -3.080
------------------------------------------------------------------------------
Critical values from MacKinnon (1990, 2010)

. egranger yur era

Engle-Granger test for cointegration                 N (1st step)  =       120
                                                     N (test)      =       119
------------------------------------------------------------------------------
                Test         1% Critical       5% Critical      10% Critical
              Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)           -1.491            -3.990            -3.388            -3.080
------------------------------------------------------------------------------
Critical values from MacKinnon (1990, 2010)

. egranger yer sra

Engle-Granger test for cointegration                 N (1st step)  =       120
                                                     N (test)      =       119
------------------------------------------------------------------------------
                Test         1% Critical       5% Critical      10% Critical
              Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)           -1.914            -3.990            -3.388            -3.080
------------------------------------------------------------------------------
Critical values from MacKinnon (1990, 2010)

. egranger yer era

Engle-Granger test for cointegration                 N (1st step)  =       120
                                                     N (test)      =       119
------------------------------------------------------------------------------
                Test         1% Critical       5% Critical      10% Critical
              Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)           -2.004            -3.990            -3.388            -3.080
------------------------------------------------------------------------------
Critical values from MacKinnon (1990, 2010)
```

Table 3.7. RESET test

```
Ramsey RESET test using powers of the fitted values of dyur
       Ho:  model has no omitted variables
                  F(3, 75) =      1.37
                  Prob > F =      0.2589

Ramsey RESET test using powers of the fitted values of dyur
       Ho:  model has no omitted variables
                  F(3, 27) =      6.34
                  Prob > F =      0.0021

Ramsey RESET test using powers of the fitted values of dyur
       Ho:  model has no omitted variables
                  F(3, 75) =      1.40
                  Prob > F =      0.2503

Ramsey RESET test using powers of the fitted values of dyur
       Ho:  model has no omitted variables
                  F(3, 27) =      7.70
                  Prob > F =      0.0007

Ramsey RESET test using powers of the fitted values of dyer
       Ho:  model has no omitted variables
                 F(3, 111) =      0.89
                  Prob > F =      0.4494

Ramsey RESET test using powers of the fitted values of dyer
       Ho:  model has no omitted variables
                 F(3, 111) =      0.24
                  Prob > F =      0.8662
```

Table 3.8. BG test

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
1	**5.524**	**1**	**0.0188**
2	**10.192**	**2**	**0.0061**
3	**10.426**	**3**	**0.0153**
4	**14.351**	**4**	**0.0063**

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
1	**2.951**	**1**	**0.0858**
2	**11.801**	**2**	**0.0027**
3	**11.921**	**3**	**0.0077**
4	**12.730**	**4**	**0.0127**

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
1	**5.709**	**1**	**0.0169**
2	**10.280**	**2**	**0.0059**
3	**10.576**	**3**	**0.0143**
4	**14.813**	**4**	**0.0051**

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
1	**1.896**	**1**	**0.1685**
2	**11.599**	**2**	**0.0030**
3	**11.604**	**3**	**0.0089**
4	**12.074**	**4**	**0.0168**

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
1	**13.016**	**1**	**0.0003**
2	**14.358**	**2**	**0.0008**
3	**30.332**	**3**	**0.0000**
4	**39.561**	**4**	**0.0000**

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
1	**15.305**	**1**	**0.0001**
2	**16.134**	**2**	**0.0003**
3	**28.092**	**3**	**0.0000**
4	**39.567**	**4**	**0.0000**

Appendix B - Figures

Figure 3.10. Pearson correlation coefficient - Aggregated case

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9104	1.0000		
oer_sra	0.0493	-0.3631	1.0000	
oer_era	0.1469	-0.4706	0.9397	1.0000

Figure 3.11. Pearson correlation coefficient - By gender

Male

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9138	1.0000		
oer_sra	-0.4095	0.1306	1.0000	
oer_era	-0.4391	0.1552	0.8308	1.0000

Female

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.8901	1.0000		
oer_sra	0.3458	-0.6439	1.0000	
oer_era	0.4200	-0.7144	0.9766	1.0000

Figure 3.12. Pearson correlation coefficient - By educational attainment

Basic

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.8903	1.0000		
oer_sra	-0.5771	0.2283	1.0000	
oer_era	-0.3711	-0.0052	0.8629	1.0000

Intermediate

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.3309	1.0000		
oer_sra	0.0865	0.3213	1.0000	
oer_era	0.1263	0.2145	0.9361	1.0000

Advanced

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.7529	1.0000		
oer_sra	-0.3667	-0.0755	1.0000	
oer_era	-0.2654	-0.1714	0.9477	1.0000

Figure 3.13. Pearson correlation coefficient - By region

Norte

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9147	1.0000		
oer_sra	-0.0087	-0.3150	1.0000	
oer_era	0.0335	-0.3530	0.9382	1.0000

Centro

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.8936	1.0000		
oer_sra	0.2435	-0.3653	1.0000	
oer_era	0.3308	-0.4932	0.9551	1.0000

AML

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.8550	1.0000		
oer_sra	-0.0633	-0.2532	1.0000	
oer_era	0.0751	-0.3927	0.9378	1.0000

Alentejo

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.7637	1.0000		
oer_sra	-0.0832	-0.4112	1.0000	
oer_era	-0.0049	-0.4811	0.9419	1.0000

Algarve

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.8529	1.0000		
oer_sra	-0.0779	0.0001	1.0000	
oer_era	-0.0574	-0.0178	0.9573	1.0000

RAA

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9176	1.0000		
oer_sra	0.3996	-0.5238	1.0000	
oer_era	0.4900	-0.6207	0.9737	1.0000

RAM

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9124	1.0000		
oer_sra	-0.3538	0.1470	1.0000	
oer_era	-0.2781	0.0697	0.9466	1.0000

Figure 3.14. Spearman correlation coefficient - Aggregated case

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9594	1.0000		
oer_sra	0.1134	-0.1997	1.0000	
oer_era	0.2622	-0.3599	0.7697	1.0000

Figure 3.15. Spearman correlation coefficient - By gender

Male

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9579	1.0000		
oer_sra	-0.3852	0.2901	1.0000	
oer_era	-0.3819	0.2737	0.7624	1.0000

Female

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9432	1.0000		
oer_sra	0.6720	-0.7509	1.0000	
oer_era	0.7129	-0.7958	0.9676	1.0000

Figure 3.16 Spearman correlation coefficient - By educational attainment

Basic

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9191	1.0000		
oer_sra	-0.4657	0.2249	1.0000	
oer_era	-0.4178	0.1624	0.8371	1.0000

Intermediate

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.3585	1.0000		
oer_sra	0.2402	0.2595	1.0000	
oer_era	0.2763	0.1794	0.9412	1.0000

Advanced

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.7525	1.0000		
oer_sra	-0.4302	0.0189	1.0000	
oer_era	-0.2956	-0.1323	0.9243	1.0000

Figure 3.17. Spearman correlation coefficient - By region

Norte

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9452	1.0000		
oer_sra	-0.0745	-0.0614	1.0000	
oer_era	-0.0239	-0.1604	0.7060	1.0000

Centro

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9282	1.0000		
oer_sra	0.3005	-0.3407	1.0000	
oer_era	0.4794	-0.5316	0.9021	1.0000

AML

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9173	1.0000		
oer_sra	-0.0524	-0.0687	1.0000	
oer_era	0.2044	-0.2939	0.7511	1.0000

Alentejo

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.7440	1.0000		
oer_sra	-0.0156	-0.4203	1.0000	
oer_era	0.1441	-0.5379	0.8882	1.0000

Algarve

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.8150	1.0000		
oer_sra	-0.0489	0.0404	1.0000	
oer_era	-0.0084	0.0040	0.9143	1.0000

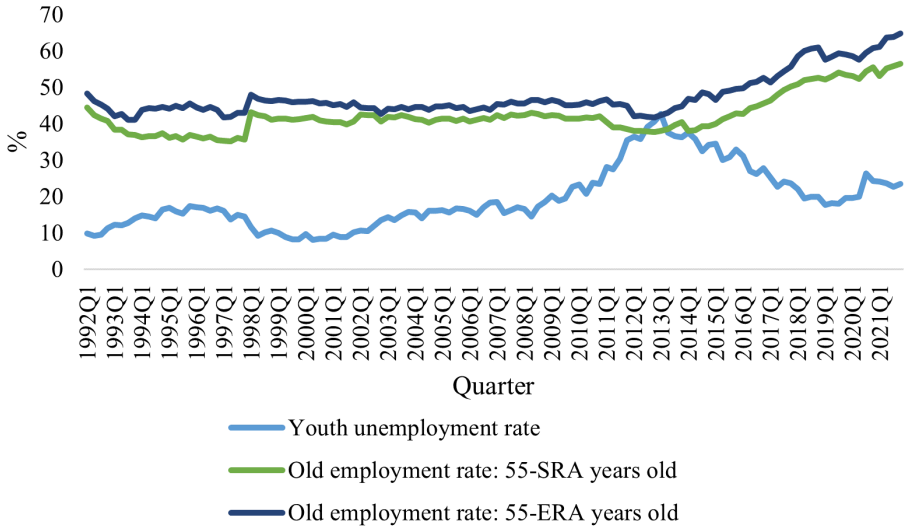
RAA

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.9358	1.0000		
oer_sra	0.4696	-0.5072	1.0000	
oer_era	0.5421	-0.5798	0.9720	1.0000

RAM

	yur	yer	oer_sra	oer_era
yur	1.0000			
yer	-0.8782	1.0000		
oer_sra	-0.2912	0.1689	1.0000	
oer_era	-0.1693	0.0982	0.9456	1.0000

Figure 3.18. Youth unemployment rate and old employment rates



Source: Author's calculations