

## **POLICY PAPER**

# **Estimating, and Interpreting, Retirement Income Replacement Rates**

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*Abstract:* Longitudinal data are used to estimate retirement income replacement rates (RRs) of employees in Ireland who transitioned into retirement between 2010 and 2016. The median RR is estimated at 47 per cent, meaning that the majority of the retirees replaced less than half of their pre-retirement earnings with pension income. The distribution of RRs is highly skewed, with a mean of 73 per cent. The mean value seems high relative to stated policy goals, but the estimate is driven partly by very high RRs at the lower end of the earnings distribution. When a more comprehensive measure of income – incorporating pre-retirement pension income, post-retirement labour earnings and social welfare payments – is used, the mean RR falls to 52 per cent. The findings highlight the need for understanding the distribution of replacement rates and leads to a question as to whether policy goals in the areas of pension adequacy should be set with respect to income or consumption levels as opposed to RRs.

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## I INTRODUCTION

The adequacy of pension income has been to the fore in policy discussions for many years and in many countries. As noted by Mitchell and Phillips (2006) replacement rates are often used in these discussions. However, Mitchell and Phillips (2006), Biggs and Springstead (2008), Brady (2010) and MacDonald *et al.* (2016) have all raised questions about the definition of replacement rates in the context of pensions. Similarly, they have each questioned the meaningfulness of policy targets that are stated in terms of replacement rates which are often loosely defined.

Ireland is among those countries where policymakers have been, and continue to be, concerned about pension adequacy. Across the National Pensions Policy Initiative (The Pensions Board, 1998), the Green Paper on Pensions (The Department of Social and Family Affairs, 2007), an OECD review of the Irish pension system (OECD, 2014) and the Roadmap for Pensions Reform (Government of Ireland, 2018), targets have been set with respect to pension coverage and adequacy. In the case of the 2007 Green Paper, it was suggested that policy should aim to see State-provided and supplementary pensions combining to replace “50 per cent of pre-retirement earnings” (para 1.12). The 2018 Roadmap for Pensions Reform refers to a replacement of

*a sufficient proportion (e.g. 50 per cent – 60 per cent) of an individual’s pre-retirement earnings so as to enable the individual concerned to maintain a reasonable standard of living after retirement (p.14).*

In this paper, we provide new estimates of retirement income replacement rates for Ireland. Our objective in doing this is two-fold. First, we want to build on previous work by Nivakoski (2014) and to look at the distribution of replacement rates. Ireland is somewhat unusual amongst OECD countries in that state social welfare pensions are generally flat-rate and not earnings related. As shown by Nivakoski, this leads to a distribution of replacement rates which is much more equal when compared to the distribution in earnings. Nivakoski’s earlier work was based on cross-sectional data but in this paper we use longitudinal data which offer advantages that are set out below. Our second goal is to assess what our estimates imply about the appropriateness of a policy goal such as a 50 per cent replacement rate. We find high replacement rates for low earners, so the question arises as to whether the actual level of income in retirement is a more meaningful policy goal below some point in the income distribution.

This paper uses data from The Irish Longitudinal Study on Ageing (TILDA). As TILDA is a longitudinal study, the same survey participants have been interviewed at Wave 1 (mainly in 2010), Wave 2 (in 2012), Wave 3 (in 2014) and Wave 4 (in 2016). As a result of this survey design, we are able to identify people

who are employed at one survey wave but retired by the next. This allows us to examine changes to income in real time, thereby reducing any possibility of recall error which may have impacted upon Nivakoski's earlier results. The data also facilitate an examination of how replacement rates vary across a number of factors such as gender, education and occupation. By generating these real-time data on replacement rates using a representative sample of the population, we aim to provide an important input into the ongoing policy deliberations, mentioned above.

This paper is structured as follows. In the remainder of this introduction, we provide a brief overview of Ireland's pensions system. In Section II, we describe the data in more detail and how the sample used in the analysis is constructed. We also describe how we calculate the key variable of interest, the retirement income replacement rate. In Section III, we present our findings on replacement rates and how the rates vary across groups. Section IV estimates replacement rates using a more comprehensive measure of income. Section V concludes with some reflections on the policy implications.

We turn now to the brief description of Ireland's pension system. The Irish pension system can be divided into three pillars: i) State welfare pensions, ii) occupational pensions, and iii) private pensions.<sup>1</sup> The first pillar provides a basic level of income for older people, and it is paid to most people of pension age. The other two (supplementary pension) pillars are typically linked to earnings.

As mentioned above, the first pillar pensions are flat-rated (not linked to earnings), providing a basic level of income. These payments consist of the Contributory and Non-contributory State welfare pensions.<sup>2</sup> To qualify for either of these pensions, an individual must have reached the State Pension Age (SPA) of 66 years.<sup>3</sup> Entitlements to the Contributory pension, delivered on a pay-as-you-go (PAYG) basis from the Social Insurance Fund (SIF), are built up over the working life of an individual through the accumulation of Pay Related Social Insurance (PRSI) credits, and the payments are not means-tested. During the collection of data used in this analysis, the maximum gross payment rate ranged from €230.30 to €233.30 per week per person. The Non-contributory State welfare pension is a means-tested payment. It is not dependent on past employment history and is financed through general taxation. In order to qualify for the Non-contributory State welfare pension, a person must not be eligible for the Contributory State welfare pension, must pass a means test based on both income and wealth, and be habitually resident in Ireland. Between 2010 and 2016, the maximum pre-tax rate of payment ranged from €219 to €222 per week per person.

<sup>1</sup> More details are found in the Department of Social and Family Affairs (2007) and OECD (2014).

<sup>2</sup> The Transition State welfare pension was payable from age 65 but had higher contribution requirements than the Contributory State welfare pension. It was abolished in 2014.

<sup>3</sup> State Pension Age (SPA) is depends on the year of birth of the individual as outlined in the Social Welfare and Pensions Act of 2011. It is 66 for those born before 1954, 67 for those born between 1954 and 1960, and 68 for those born in or after 1961.

The second and third pillars consist of supplementary pensions, over and above the State welfare pensions. Contributions to supplementary pensions are deductible from income taxation (up to certain limits). Occupational pensions are common in public sector employment in Ireland but are also a feature of private sector employment, especially in larger firms, where most schemes are funded. There is no legal obligation for employers to provide occupational pension schemes. Public service occupational pension schemes are in place for staff in the civil service, local authorities, An Garda Síochána (the Irish police), the defence forces, the health and education sectors and non-commercial State bodies. Public service pension schemes are mainly statutory, and virtually all of the schemes are financed on a PAYG basis. Private pensions are voluntary and consist of Retirement Annuity Contracts (RACs) and Personal Retirement Savings Accounts (PRSAs). RACs are commonly used by the self-employed. PRSAs were introduced in 2002 with an aim of increasing pension coverage among low-coverage employee groups. Contributions to private pension plans are generally made by the employee only. Employers must offer access to a PRSA to any employee who is not eligible to join an occupational pension scheme.

## **II THE DATA, THE SAMPLE AND THE METHODOLOGY**

The data for this analysis come from The Irish Longitudinal Study on Ageing (TILDA). The data collection under TILDA began in 2009. Information was gathered on a sample of over 8,000 people aged 50 and over and their partners and spouses, including those aged under 50. The first wave achieved a response rate of 62 per cent. The survey covers topics such as income and wealth, demographics, health and labour force status. A detailed health assessment was conducted in Wave 1 and repeated every second subsequent wave. The longitudinal structure of TILDA data makes it possible to examine changes in peoples' circumstances, including labour force status, health status, and living arrangements. Income changes could also be identified.

In this paper, we exploit the longitudinal nature of TILDA and it is important to describe how we arrive at the sample used in the analysis that follows. We focus on people who were interviewed in more than one wave and who describe themselves as being "employed" in one wave (1, 2 or 3) and then "retired" in the subsequent wave (2, 3 or 4). The number of respondents falling into this category is 633. However, we can only use cases where people have provided us with income data in both their pre- and post-retirement interviews, and for whom survey weights are available. For this reason, our sample size falls to 501.

In Table 1, we present summary statistics on our main analysis sample (in Column 2). In addition, in Column 1, we provide information on all employees

**Table 1: Description of all Employed, and Those Who Subsequently Retire**

	<i>All employees Per cent</i>	<i>Transition into retirement Per cent</i>
<b>Age</b>		
<60 years	70.9%	37.7%
60-70 years	27.8%	59.4%
>70 years	1.3%	2.9%
<b>Gender</b>		
Female	54.0%	52.3%
Male	46.0%	47.7%
<b>Education</b>		
Primary/none	13.4%	16.2%
Secondary	49.7%	49.1%
Third/higher	36.8%	34.7%
<b>Location</b>		
Dublin	28.5%	33.3%
Other town/city	30.2%	33.9%
Rural	41.3%	32.8%
<b>Employment sector</b>		
Private	52.2%	43.5%
Public	47.8%	56.5%
<b>Part-time/Full-time</b>		
Part-time	26.5%	33.6%
Full-time	73.5%	66.4%
<b>Marital Status</b>		
Married	72.4%	68.1%
Never married	11.4%	13.4%
Separated/divorced	11.3%	10.1%
Widowed	4.8%	8.3%
<b>Occupation type</b>		
Professional/Managerial/Technical	27.9%	39.3%
Non-manual/Skilled manual	45.4%	40.0%
Semi-skilled/Unskilled	26.6%	20.7%
<b>Earnings category (euro/week, gross)</b>		
0	1.5%	0.0%
1-299	17.4%	20.6%
300-699	36.1%	30.2%
700-1000	18.4%	17.0%
1000+	26.5%	32.3%
<b>Has supplementary pension</b>		
No	34.9%	36.4%
Yes	65.1%	63.6%
<b>Sample size</b>	<b>5,039</b>	<b>501</b>

Source: Authors' analysis.

in the data so that comparisons between the two groups are possible. Survey weights are applied in all of the analyses presented.

Examining Column 1 of Table 1, two elements that are potentially surprising are i) the higher number of public sector employees (in comparison with private sector employees) and ii) the gender split. Comparing these estimates with data from the CSO's Quarterly National Household Survey (QNHS), the estimates are somewhat similar for the age group in question: the QNHS data for 2010 show that 42 per cent of employees aged 50 to 64 were working in the public sector. The ratio of women to men in our sample of employees is 54/46. Women have been more prevalent among employees in Ireland since 2008 (Central Statistics Office, 2018; Collins, 2016). In the 2011 Census, 53 per cent of employees aged 45 or over were women (Central Statistics Office, 2018). Although in Ireland, men are more likely to work than women are, men are also more likely to be self-employed. As we are excluding the self-employed, this explains the gender balance in the sample.

Examining Column 2 in Table 1, the majority of those retiring are aged 60-70 and the age distribution of those retiring is very different from the age distribution of employees, as expected. There appear to be higher rates of retirement among higher SES groups (indicated by education, occupation and income), possibly reflecting that lower-income individuals are less likely to retire due to insufficient financial resources. Supporting the hypothesis of gradual retirement (Kantarci and Van Soest, 2008), whereby individuals smooth their transition into retirement, we find that those working part-time and those in the lowest labour earnings category are more likely to retire. We see higher rates of retirement among public sector employees compared to their proportion among employees as a whole. This may have been a function of retirement arrangements in place for public servants. Because of the prevalence of public sector employee retirements in the data, subsequent analyses present the data separately for public and private sector retirees.

Having described the data and the sample, the last item to be discussed before presenting the analysis is the calculation of the retirement income replacement rate. The basic formula is as follows:

$$\text{Replacement Rate} = \frac{\text{Pension Income}}{\text{Labour Earnings}} \times 100$$

For each individual, pension income refers to gross weekly income and is made up of (a) the state welfare pension (pillar (i)), (b) occupational pension income (pillar (ii)) and (c) private pension income (pillar (iii)). Gross weekly labour earnings data are taken from the survey wave where they indicated that they were still "employed".

In a later section of our analysis, we estimate the replacement rate for our sample, using an alternative definition:

$$\text{Replacement Rate} = \frac{\text{Retirement Income}}{\text{Pre-retirement Income}} \times 100$$

Retirement income is measured in the survey wave in which the individual declares themselves as “retired”, and it consists of pension income (as defined above), labour earnings and social welfare payments. Pre-retirement income is a sum of labour earnings, pension income (in the pre-retirement wave), and social welfare payments. This more comprehensive measure of income is used in order to assess the sensitivity of our findings to how the replacement rate is defined. In particular, the alternative definition of replacement rate may affect the findings if the social welfare system plays an important role in income provision for pre-retirees (who may be working part-time) or retirees (with limited pension provision), or if retirees are in receipt of some pension payments prior to the retirement transition.

Adjustment for inflation has been made in all calculations that follow, so that all income figures are presented as 2010 euros.

### III INCOMES AND REPLACEMENT RATES

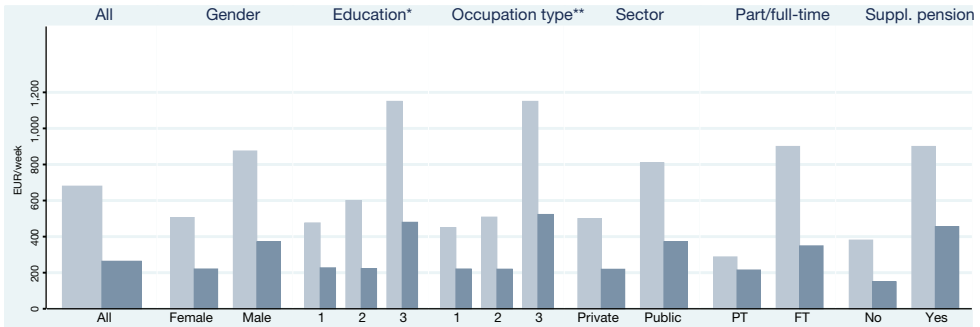
We now turn to the main objective of the paper and present estimates of replacement rates and the distribution of the rates. We begin our presentation by examining the distribution of labour earnings for our retiring sample and will then look at post-retirement pension incomes before bringing the two together as replacement rates. We do this because the patterns observed for replacement rates will be better understood if the underlying components are known.

In Figure 1, the light bars show pre-retirement labour earnings and the dark bars show post-retirement pension income. The figures are also presented in number form in part A of Appendix Table A.1, along with means and the interquartile ranges. The distribution of labour earnings is shown with the solid line in the first part of Appendix Figure A.1. When presenting our findings, our emphasis is on medians which are more representative of central tendency in the case of highly skewed distributions. In our sample of retiring weekly labour earnings, the median is €680, with the mean being €854. These values differ across different groups and in expected ways. For example, the median weekly labour earnings for men is €875, whereas for women it is €506. These figures imply a female-to-male wage ratio of 58 per cent.<sup>4</sup> Labour income rises with education and with occupational level.

<sup>4</sup> Eurostat figures of the gender pay gap suggest that between 2011 and 2014 in Ireland, women’s gross hourly earnings were between 12 and 14 per cent lower than those of men (Central Statistics Office, 2017). Figures from the National Employment Survey show that the female-to-male ratio of the mean annual earnings in 2009 was between 61 and 63 per cent, depending on whether bonuses and benefits-in-kind were included (Central Statistics Office, 2011).

Public sector employees are shown to earn more than private sector employees, as do full-time workers in comparison with part-time workers. Finally, those with supplementary pension coverage have higher earnings than those who are not covered.

**Figure 1: Median Labour Earnings and Pension Income (2010 Euros Per Week, Gross)**



**Light bar:** labour earnings      **Dark bar:** pension income

Source: Authors’ analysis.

\* Education level: 1: None/primary, 2: Secondary, 3: Third level/higher.

\*\* Occupation types: 1: Semi-skilled/Unskilled, 2: Non-manual/Skilled manual, 3: Professional/Managerial/Technical.

The means, medians and interquartile ranges of total pension income are presented also in part A of Appendix Table A.1. The distribution of total pension income is shown with the solid line in the second part of Appendix Figure A.1. Median pension income is €264; the mean is €406. The male median is €371 and that for females is €221. The implied female-to-male ratio is 60 per cent.

As would be expected, pension incomes rise with education levels and with occupation levels and are higher for public sector workers. However, in each case labour earnings were also shown to be higher. Therefore, the difference in replacement rates between these groups depends on the level of pension income these groups receive relative to their previous labour earnings.

A further building block before looking directly at replacement rates is to consider how pension income is made up across the three sources – the three pillars of pension income – for people in our sample. As with the presentation in the earlier figures, an understanding of pension income by source will aid in understanding the replacement rates patterns. The means, medians and interquartile ranges of pension incomes from different pensions (state welfare pensions, occupational pensions and private pensions) are listed in Appendix Table A.2. As the zeros in



the percentile columns of Table A.2 indicate, there is low incidence of receipt of income from the individual pensions. For this reason, and because the income component means sum up to the mean total pension income, we discuss the mean figures.

The mean total pension income of €406 is made up of the following components: a mean state social welfare pension of €88; a mean occupation pension payment of €305; a mean private pension payment of €12. These figures imply that 22 per cent of mean pension income is made up of the social welfare pension (€88/€406). However, this average of 22 per cent hides large variation across groups and this is best illustrated by the educational categories. For those with low levels of education, the social welfare pensions make up 62 per cent of their pension income. For those with high levels of education the corresponding figure is 7 per cent. This points to the importance of the social welfare pensions for lower income groups and the impact of this component of pensions on replacement rates will be seen below. The importance of social welfare pensions in income provision at the bottom deciles of the income distribution among retirees is highlighted also in Collins and Hughes (2017) and Gallagher and Ryan (2017).

An examination of labour earnings and pension income medians together in Figure 1 reveals that although both vary, there is less variation in the proportionate falls between both types of income across the various breakdowns. This leads to an expectation of lower variability in replacement rates compared to either labour or pension incomes and this is what emerges as we examine medians of retirement income replacement rates in part a) of Figure 2.

The first point to be read from Figure 2a is that the median replacement rate is 47 per cent, meaning that more than half of retirees replace less than half of their earnings in retirement with pension income. The distribution of replacement rates is shown with the solid line in Appendix Figure A.2. The distribution of replacement rates is bimodal, with two distinct peaks: one near zero, and the other near 50.<sup>5</sup> The distribution is skewed towards some high values, reflected in the mean value being 73 per cent.<sup>6</sup> Given the stated policy target of 50 per cent replacement rates, the mean estimate is perhaps surprisingly high, with the median value being more in line with expectations.

When we look beyond the overall value, some interesting points emerge. The median replacement rate does not vary significantly by gender: it is 46 per cent for women and 48 per cent for men. Examining the mean values, the female replacement rate is higher than the male replacement rate – 81 per cent for women

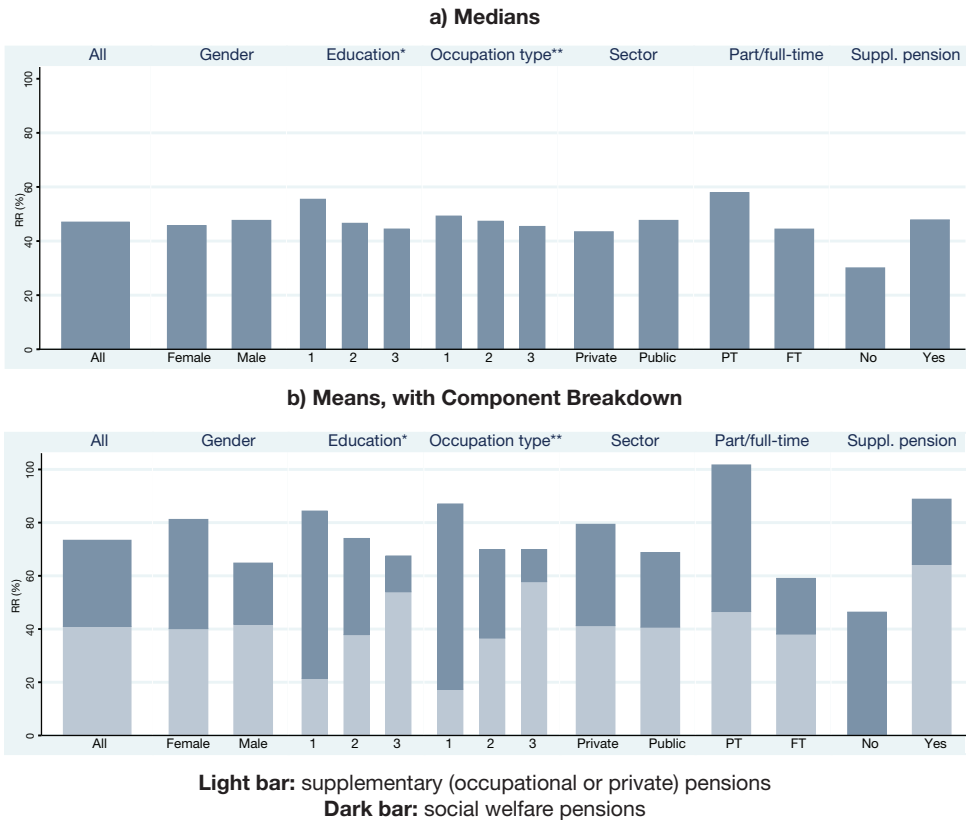
<sup>5</sup> The solid lines in Appendix Figure A.3 show the distribution of replacement rates stratified by gender, education, etc.

<sup>6</sup> When comparing average earnings and pension incomes with average replacement rates, one needs to bear in mind that the mean of the ratios of two variables is not equal to the ratio of their means. Therefore, the ratio of mean pension income (€406) to mean labour earnings (€854) – which is 48 per cent – does not equal the mean of the (individually calculated) replacement rates (73 per cent).

and 65 per cent for men. While a higher replacement rate for women might appear, at face value, to be a positive finding for women, it should be understood that the higher replacement rate results from lower female earnings. This illustrates the point made above of the need to understand the components of the replacement rates.

In spite of the fact that there is a positive relationship between education level and both labour earnings and pension income, there is a negative relationship between education level and (median and mean) replacement rates. Third, and echoing the finding with respect to education, the lowest-skilled occupation group has the highest replacement rates. The median replacement rate for the highest-skilled occupation group is 45 per cent, and this rises to 49 per cent for the lowest-skilled group.

**Figure 2: Retirement Income Replacement Rate**



Source: Authors' analysis.

\*Education level: 1: None/primary, 2: Secondary, 3: Third level/higher.

\*\* Occupation types: 1: Semi-skilled/Unskilled, 2: Non-manual/Skilled manual, 3: Professional/Managerial/Technical

The broad picture to emerge is of a greater degree of equality with respect to retirement income replacement rates when compared to incomes either before or after retirement. This feature of Ireland's pension system was also observed by Nivakoski (2014) who went on to explore the role played by the social welfare pensions in bringing about this pattern. We follow this approach and explore the component parts of (mean) replacement rates, shown in Figure 2b.

A strong and fascinating picture emerges of the key role played by the social welfare pensions in equalising outcomes. Focussing on the education component of the figure, it can be seen how replacement rates based only on supplementary pensions (occupational and private) result in a positive relationship between education level replacement rates. However, the impact of the social welfare pension is to boost replacement rates for lower educational groups to a much greater extent (proportionately) and so the pattern for total replacement rates is reversed. A similar picture emerges with respect to occupation.

Examining differences between individuals retiring from public and private sector employment, it can be seen that estimated median replacement rates are 48 and 43 per cent respectively. The mean values are higher for people retiring from the private sector (79 per cent) compared to people retiring from the public sector (69 per cent). Examining the interquartile range, it is evident that replacement rates are more varied among private sector retirees. A decomposition of replacement rates into social welfare and supplementary pension components provides one clue as to the source of this result. It can be seen from Figure 2b that if we only consider supplementary (occupational and private) pensions, the mean replacement rates are equal across the sectors. As with our analysis of education and occupation above, the inclusion of social welfare pensions alters the pattern. As many of the public servants in our sample would not have had access to the State social welfare pension,<sup>7</sup> the observed pattern seems plausible.

We look next at the relationship between replacement rates and labour earnings. Our analysis above of the relationship between education and occupational levels and replacement rates suggests that replacement rates are more equally distributed than incomes – both labour and pension incomes – so a direct examination of the relationship between labour earnings and subsequent replacement rates is of interest.

As with our approach above, it is useful to look first at the components of the replacement rate separately, so that the pattern of replacement rates is more readily understood. In Figure 3a, we stratify the sample of retiring individuals by their pre-retirement earnings quintile<sup>8</sup> and examine their labour earnings and pension income.

<sup>7</sup> Public servants appointed since 1995 receive “integrated” occupational and State welfare pensions, meaning that public service occupational pension is reduced by the amount of the State welfare pension (The Department of Social and Family Affairs, 2007).

<sup>8</sup> The pre-retirement earnings distribution of our sample is depicted in the first part of Figure A.1 in the Appendix.

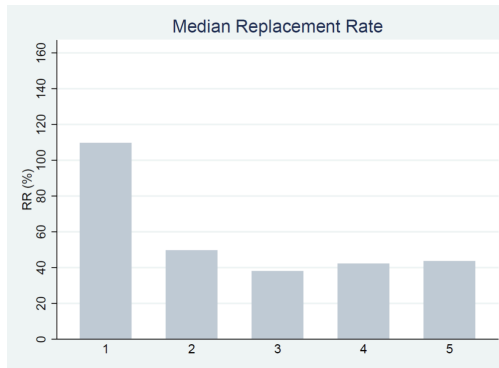
**Figure 3: Analysis by Labour Earnings Quintile**

**a) Median Labour Earnings and Pension Income (2010 Euros Per Week, Gross)**

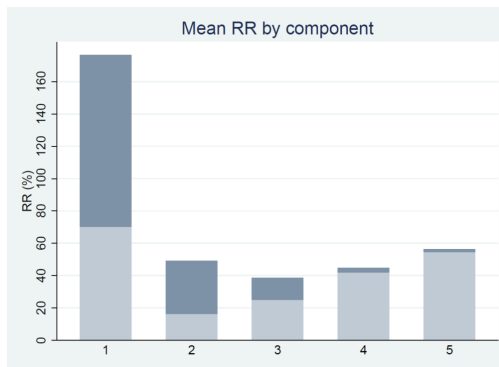


**Light bar:** labour earnings      **Dark bar:** pension income

**b) Median Retirement Income Replacement Rate**



**c) Mean retirement Income Replacement Rate, with Component Breakdown**



**Light bar:** supplementary (occupational or private) pensions      **Dark bar:** social welfare pensions

Source: Authors' analysis.

One point to emerge is that, although both pension and labour incomes rise across the quintiles, the rise for labour income is steeper.

Turning to replacement rates, Figures 3b and 3c present median and mean estimates across the earnings quintiles, with the latter graph illustrating the proportion of mean replacement rate that is attributable to State welfare pensions on one hand, and supplementary pensions on the other. Firstly examining Figure 3b, we see a U-shaped pattern of median replacement rates across the earnings distribution, mirroring the findings of Nivakoski (2014) who found a similar relationship between replacement rates and education among Irish retirees. The high replacement rates (with median in excess of 100 per cent) in the first earnings quintile arise in part from some very low reported labour earnings, possibly due to part-time work. The mean values of replacement rates, although influenced by outliers at the right tail of the distribution, are shown in Figure 3c and they illustrate how supplementary pensions provide lower replacement rates for quintiles 2 and 3 compared with the top two quintiles. However, the increase in the replacement rate provided by the social welfare pensions is much more significant in quintile 2 and so the U-shape emerges as a result of the state social welfare pension.

As a final strand in our analysis of replacement rates, we use OLS regression analysis to jointly assess the statistical significance of the various factors related to income levels and in replacement rates in the bivariate analysis above. The dependent variable in Models 1, 2 and 3 are weekly gross labour earnings, total pension income, and replacement rate, respectively.

Usually, the focus of discussion on a table of regression results is the sign and significance of the coefficients of various explanatory variables. However, the key point here is the reduction in the number of significant coefficients as we move from Model 1, through Model 2 and on to Model 3. Looking at Model 1 we see a somewhat standard model where labour earnings are determined by variables such as education and occupation. The statistical significance of these determinants diminishes when Model 2 is estimated, with occupation no longer significant. This finding reflects the equalising effect of the Irish pension system, and this is further reflected in Model 3, where only the indicator variables indicating full-time work, public sector employment and having a supplementary pension are significantly associated with the replacement rate level.

#### **IV COMPREHENSIVE INCOME MEASURES**

This section re-estimates retirement income replacement rates using a more comprehensive measure of income. Both pre- and post-retirement, income (at the individual level) from all sources is taken into consideration, with the exception of asset income. Income sources that are included in the calculation are labour income from employment, all pension income, and all social welfare income.

**Table 2: OLS Regression Results**

	1 <i>Labour earnings</i>	2 <i>Pension income</i>	3 <i>Replacement rate</i>
Female	-102.8	-91.0	14.4
	-84.6	-65.9	-14.4
Education: Primary/none (ref.)	–	–	–
	–	–	–
Education: Secondary	233.9***	46.8	-8.6
	-80.9	-46.6	-19.2
Education: Third level/higher	440.5***	233.3*	-11.8
	-76.4	-131.3	-18.3
Semi-skilled/Unskilled (ref.)	–	–	–
	–	–	–
Non-manual/Skilled manual	84.0	66.7	-27.3
	-57.4	-52.6	-26.3
Professional/Managerial/Technical	393.1***	92.0	-33.0
	-101.9	-85.0	-29.4
Public sector	-124.5	-38.5	-25.9*
	-107.8	-84.9	-15.0
Full-time	380.3***	34.5	-55.9***
	-80.3	-46.0	-16.6
Has supplementary pension	259.9***	382.6***	76.9***
	-95.5	-64.4	-16.7
Constant	103.1	40.6	100.9***
	-93.6	-83.7	-17.9
Observations	501	501	501
R-squared	0.201	0.107	0.086

Source: Authors' analysis.

Note: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Weighted data. Monetary variables in 2010 euros.

Asset income data are missing (due to either refusal to answer or to not knowing the answer) for approximately one-fifth of the sample. Therefore, including asset income in the measure of comprehensive income would result in a significant reduction in sample size. An analysis of the asset income data (not presented here) reveals that for the non-missing cases, median weekly income from assets in Wave 1 is €2. The distribution is highly skewed, and 90 per cent of the individuals report receiving less than €100 in asset income per week. Therefore, the exclusion of asset income is unlikely to affect the median estimates significantly.

The findings are presented in Part B of Appendix Table A.1. Overall, with the inclusion of (pre-retirement) pension income and social welfare income, the median

pre-retirement income increases to €774; an increase of 14 per cent. The mean increases by 17 per cent, to €995. The largest share of the increase is attributable to the inclusion of (pre-retirement) pension income. The comparison of the distributions of the pre-retirement income using the two different calculation methods is shown in the first part of Appendix Figure A.1, illustrating how the distribution becomes smoother and shifts to the right. Examining the comprehensive income calculations in Part B of Appendix Table A.1, the largest proportional increase in pre-retirement income is seen among part-time workers, whose median (mean) income increases by 63 (40) per cent. Sizeable increases are also seen among the groups with the lowest labour earnings: the women, the low-educated and those in low-skilled occupations.

When it comes to income in retirement, once employment income and social welfare payments are also taken into consideration, median income increases to €309; an increase of 17 per cent. The mean increases to €456, or by 12 per cent. The majority of the increase is due to the inclusion of (post-retirement) labour earnings. The largest proportional increase in the median retirement income is among the retirees without supplementary pension coverage: their median pension income is €150, and their median comprehensive retirement income is €198. The change in the overall distribution of the retirement income is shown in the second part of Appendix Figure A.1. The change to a comprehensive income measure smooths the distribution of retirement income considerably. The incidence of very low retirement income is reduced, suggesting a reduction in the subsequent number of retirees with very low replacement rates, resulting from the low value in the numerator of the replacement rate calculation.

When the comprehensive measures of pre- and post-retirement income are used, the median replacement rate remains practically unchanged at 46 per cent (compared with the previous estimate of 47 per cent) – see Part B of Appendix Table A.1. The interquartile range also remains unchanged, with the 25th percentile at 22 per cent and the 75th percentile at 68 per cent. The change in the overall distribution of the replacement rates is shown in Appendix Figure A.2. The difference is that the observations at the extremes of the distribution have been moved closer to the centre, indicated by the mean coinciding more closely with the median value. The group of observations at the left tail of the distribution has been moved right as the numerator (retirement income) has increased, transforming the distribution from a bimodal to a unimodal one. The observations at the right of the distribution have been moved towards the left as the estimate of the denominator (pre-retirement income) has increased. Examining the figures in Appendix Table A.1, it is evident that the former group primarily consists of retirees without supplementary pension coverage. The inclusion of non-pension retirement income causes the highest proportional increase in post-retirement income for them. The latter group is characterised by low-earnings individuals, such as part-time workers and employees with low levels of education.

Appendix Figure A.3 shows the distributions of replacement rates calculated using the two definitions of income, stratified by gender, education, etc. Examining the graphs, it is evident that the groups of retirees with the higher (pre- and post-retirement) incomes have most pronounced peaks in the replacement rate distributions, whereas the lower-income retirees have more variability in the replacement rates. The largest differences between the two calculation methods are unsurprisingly seen when comparing the left tail of the replacement rate distribution of retirees without supplementary pension coverage: when labour earnings and social welfare income are added to (low) post-retirement income, the numerator increases, and the replacement rate increases. Also, as suspected, the largest change in the right tail of the replacement rate distribution is observed among retirees who worked part-time prior to retirement: when pension income and social welfare payments are added to (low) pre-retirement income, the denominator increases, and the replacement rate declines.

To summarise the findings, a more comprehensive measure of income in retirement replacement rate calculations has an impact at the extremes of the replacement rate distribution, lowering the incidence of zeros and very high values. As the estimate is bound at zero at the lower end, using a comprehensive measure of income reduces some of the (unboundedly) high estimates and therefore brings the mean estimate closer to the median estimate. For the majority of retirees (with the exception of part-time workers and those without supplementary coverage), using a more comprehensive measure of income in replacement rate calculations has no significant effect on the estimate of the median or the interquartile range.

Naturally, many individuals are members of larger households, and therefore may not be solely reliant on their individual-level income in retirement. In addition, individuals may derive streams of income from their wealth. For these reasons, a low retirement income replacement rate may not necessarily equate to a low ability to smooth consumption (as an indicator of living standards) as individuals transition into retirement. However, as retirement income replacement rates continue to be used as indicators of retirement resource adequacy, analyses of how retirees are faring in this respect are of value.

## V CONCLUSION

Our analysis has produced a number of key findings. Firstly, the median retiree in our analysis sample achieves a replacement rate slightly below the “target” replacement rate of 50 per cent. The mean replacement rate of 73 per cent, on the other hand, looks very positive. However, this overall value is partly the product of extremely high values at the lower end of the earnings distribution and may be a function of low reported earnings immediately prior to retirement – possibly due to part-time work. The replacement rate values shown in Figure 3 across the second



to fifth income quintiles are possibly more representative of actual replacement rates.

We also use a more comprehensive definition of income (both pre- and post-retirement), with the addition of pre-retirement pension income, post-retirement labour earnings, and social welfare payments (before and after retirement). Using this definition, pre-retirement income is increased especially for part-time workers, and retirement income rises for individuals without supplementary pension coverage in particular. The estimated median replacement rate remains relatively stable at 46 per cent, but the mean falls to 52 per cent. This change in the mean occurs because the more comprehensive definition of income shifts some of the observations at the bottom of the replacement rate distribution to the right (by increasing the numerator in the calculation) and shifts some of the observations at the top of the replacement rate distribution to the left (by increasing the denominator).

Understanding the distribution, as well as the median and mean values, of the replacement rates is important when assessing the adequacy of retirement resources. The averages can be informative about retiring cohorts' financial well-being as a whole, but an examination of the tails of the distribution is important in identifying the groups of retirees whose income is most volatile over the retirement transition.

We have generally found the replacement rates are distributed more equally than incomes. The higher replacement rates among those in lower occupational and education groups are driven by lower earnings. A third set of findings relates to the crucial role played by the social welfare pensions in generating the greater degree of equality in replacement rates.

A number of implications can be distilled from the findings. First, the people in the data that we observe retiring are from that generation where defined benefit schemes were more prevalent. This is also the group that was somewhat immune from the economic collapse of 2007/2008. These factors lead to the question of whether future waves of retirees will have lower replacement rates and whether current retirees are part of a "golden generation" from a retirement perspective. The question is important because any weakening of policy interest based on relatively favourable outcomes for current retirees could disadvantage future retirees. In this context, there will be a need for the ongoing monitoring of replacement rates as people retire. There is also a need to project future replacement rates for representative samples of the population.

The second implication arises from the material on the distribution of replacement rates, specifically the U-shaped pattern with respect to earnings. It appears that the social welfare pensions perform a strong and successful role in raising replacement rates at the lower end of the socioeconomic distribution and that supplementary pensions work well at the upper end. However, there is a middle group who seem to do less well on the metric of replacement rates. This pattern is a challenge for other dimensions of social policy where targeted state interventions

are focused on lower socioeconomic groups and where higher groups can purchase the service in question (in this case pensions).

Third, the success of the social welfare pensions points to the need to protect this tool of social policy. The critical role of these pensions was shown in Nivakoski (2014) and has been shown here again.

Finally, we can return to the question of the implications of the findings for policy goals set in terms of replacement rates. The findings of very high replacement rates at the lower end of the earnings distribution prompts a question as to the meaning of a policy goal of achieving a single replacement rate target across the earnings distribution. If levels of income matter to people, as opposed to income ratios, then a policy stated as a single ratio might not lead to optimal outcomes. It might be more appropriate to think it terms of a sliding scale of replacement rate targets or for targets to be set in terms of income levels and not replacement rates. More broadly, and following MacDonald *et al.* (2016), it might make sense to set policy on income in retirement in a framework that emphasises the maintenance of living standards as opposed to income levels. Similarly, Brady (2010) talks about the need to replace consumption as opposed to income and shows the importance of taking into account variables such as savings and taxation, pre- and post-retirement, and also owner-occupied housing. Whichever approach is taken, the results here suggest that the single replacement rate target is unlikely to capture the multiplicity of circumstances which pensions policy must aim to address.

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## APPENDIX

Table A.1: Summary Statistics of Income (2010 Euros Per Week, Gross) and Replacement Rates

	A			B			C		
	Labour Earnings Percentile	Pension Income Percentile	Replacement Rate Percentile	Pre-Retirement Inc. Percentile	Retirement Income Percentile	Replacement Rate Percentile	Mean 25th	Mean 50th	Mean 75th
<b>All</b>	854 369	680 1100	406 153 264 512	73 22 47 68	995 480 774 1159	456 194 309 549	52	22	46 68
<b>Gender</b>									
Male	976 575	875 1200	481 215 371 536	65 30 48 63	1124 631 911 1250	539 221 390 605	53	30	47 63
Female	744 274	506 1000	337 61 221 470	81 9 46 72	876 400 625 1000	380 179 232 476	50	9	45 72
<b>Education</b>									
Third level/higher	1167 671	1150 1432	601 212 480 671	67 28 44 56	1339 800 1200 1538	678 235 514 714	54	28	44 56
Secondary	746 338	600 900	309 85 223 441	74 9 47 65	868 440 656 950	350 180 250 469	49	9	47 65
Primary/none	492 200	476 673	267 191 227 349	84 34 55 90	612 389 600 741	284 209 229 367	54	34	50 90
<b>Occupation type</b>									
Professional/Managerial/Technical	1215 800	1150 1432	567 239 523 703	70 28 45 56	1413 834 1200 1500	621 286 542 714	51	28	46 56
Non-manual/ skilled manual	689 288	508 800	345 50 220 383	70 8 47 72	790 432 625 891	396 119 223 405	51	8	44 72
Semi-skilled/ unskilled	489 200	450 671	217 180 221 265	87 32 49 88	591 330 545 730	253 191 231 334	54	32	48 88
<b>Sector</b>									
Public	902 500	809 1250	460 210 372 573	69 33 48 62	1052 550 875 1250	518 221 390 596	56	33	48 62
Private	792 274	500 1000	336 0 219 400	79 0 43 82	919 408 656 1000	374 111 223 476	47	0	43 82
<b>Type</b>									
Full-time	1038 625	900 1250	475 205 349 527	59 25 44 55	1148 655 949 1250	523 219 381 578	50	25	44 55
Part-time	492 200	288 500	270 47 215 384	102 7 58 115	687 331 468 675	317 179 220 400	55	7	50 115
<b>Has supplementary pension</b>									
Yes	1046 600	900 1250	572 276 456 609	89 35 48 67	1224 680 980 1350	617 288 476 665	59	35	48 67
No	519 240	381 667	114 0 150 219	46 0 30 73	596 351 468 675	168 0 198 221	39	0	40 73

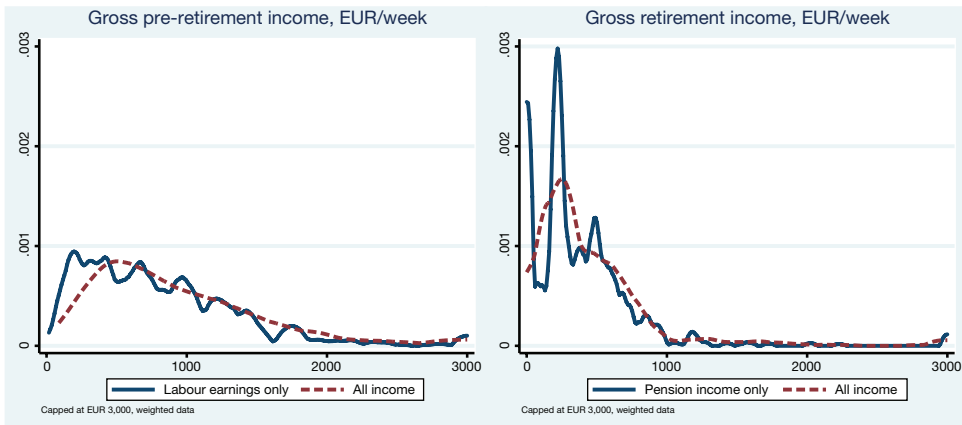
Source: Authors' analysis.

**Table A.2: Summary Statistics of Pension Income (2010 Euros Per Week, Gross)**

	State Welfare Pension			Occupational Pension			Private Pension			Total Pension Income					
	Mean	25th	75th	Mean	25th	75th	Mean	25th	75th	Mean	25th	75th			
<b>All</b>	88	0	0	216	305	0	98	476	12	0	0	406	153	264	512
<b>Gender</b>															
Male	91	0	0	219	384	0	238	518	5	0	0	481	215	371	536
Female	86	0	0	201	233	0	38	383	19	0	0	337	61	221	470
<b>Education</b>															
Third level/higher	43	0	0	0	531	71	425	662	27	0	0	601	212	480	671
Secondary	96	0	0	216	209	0	31	382	4	0	0	309	85	223	441
Primary/none	166	150	217	221	96	0	22	128	5	0	0	267	191	227	349
<b>Occupation type</b>															
Professional/Managerial/															
Technical	47	0	0	0	491	131	476	662	29	0	0	567	239	523	703
Non-manual/ skilled manual	97	0	0	217	247	0	29	286	2	0	0	345	50	220	383
Semi-skilled/ unskilled	151	0	191	221	66	0	0	63	1	0	0	217	180	221	265
<b>Sector</b>															
Public	72	0	0	187	368	8	269	536	19	0	0	460	210	372	573
Private	109	0	91	219	224	0	0	269	3	0	0	336	0	219	400
<b>Type</b>															
Full-time	78	0	0	216	379	0	191	524	18	0	0	475	205	349	527
Part-time	109	0	147	214	159	0	0	269	2	0	0	270	47	215	384
<b>Has supplementary pension</b>															
Yes	74	0	0	192	479	126	382	575	19	0	0	572	276	456	609
No	114	0	150	219	0	0	0	0	0	0	0	114	0	150	219

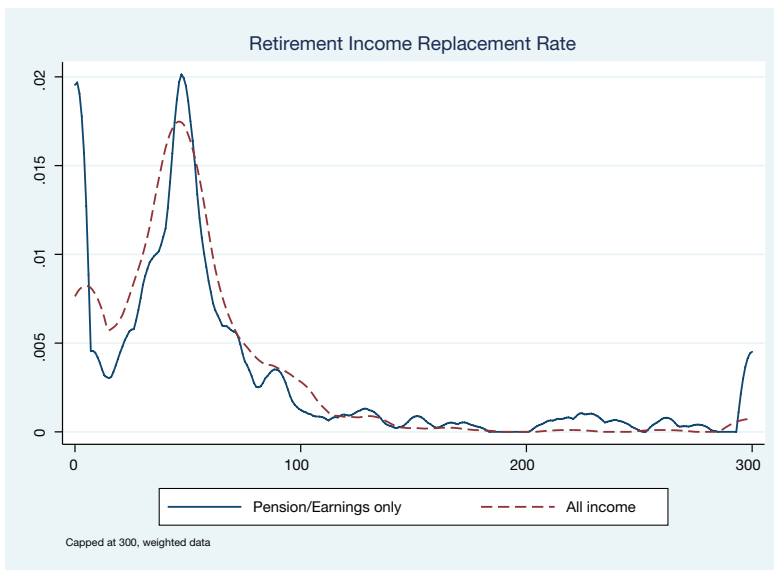
Source: Authors' analysis.

**Figure A.1: Distribution of Income (2010 Euros, Gross)**



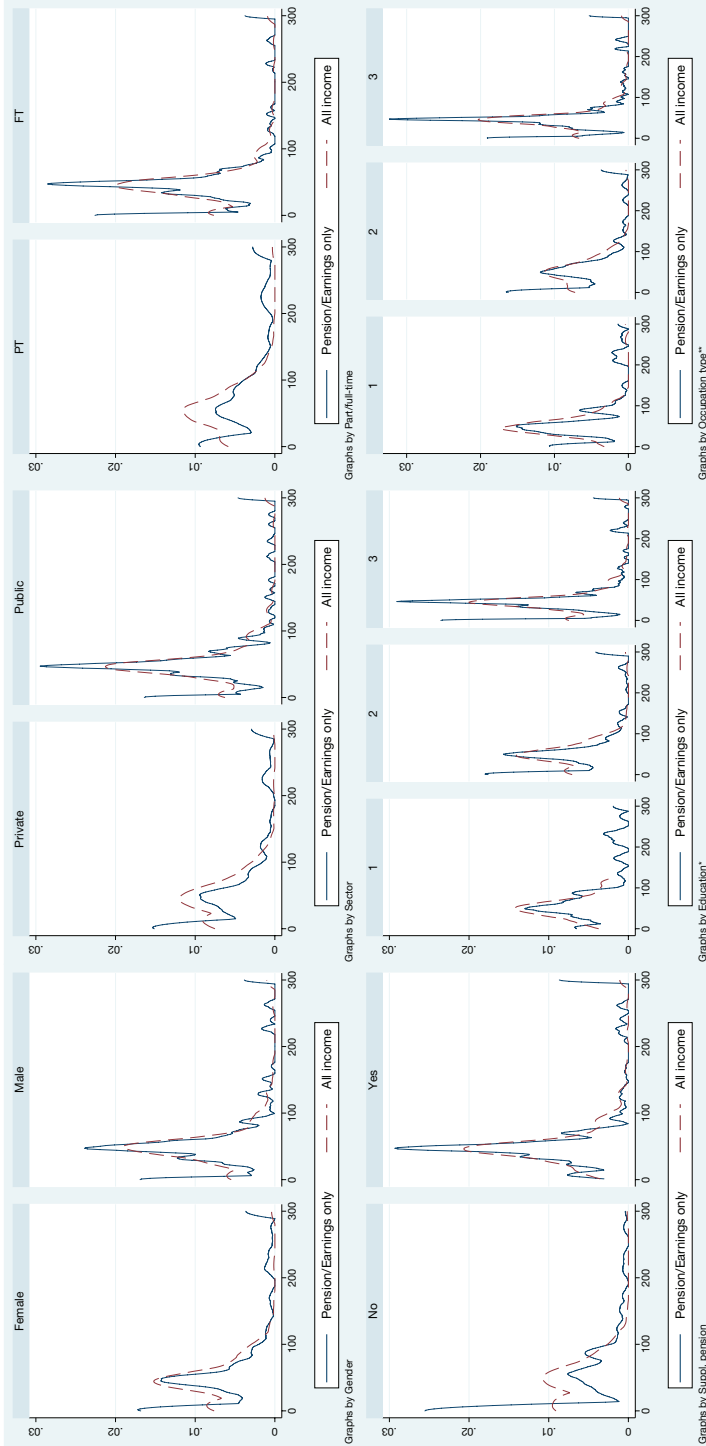
Source: Authors' analysis.

**Figure A.2: Distribution of Replacement Rates**



Source: Authors' analysis.

Figure A.3: Distribution of Replacement Rates, by Category



Source: Authors' analysis.

\*Education level: 1: None/primary, 2: Secondary, 3: Third level/higher.

\*\* Occupation types: 1: Semi-skilled/Unskilled, 2: Non-manual/Skilled manual, 3: Professional/Managerial/Technical.

