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Redistributive effects of public education and pensions over the life cycle

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Abstract

This paper assesses the redistributive effects of the two main public expenditure programs in Spain, namely, pensions and education, over the life cycle. To do so, first, the life cycle of the cohorts born between 1955 and 1975 is reconstructed using a continuous sample of working lives (MCVL in its Spanish acronym), expenditure per education level and the dynamic microsimulation model DyPeS. Second, inequality is decomposed by income source (labour, pensions and education) and worker characteristics, following a decomposition in line with Shorrocks (1982). In the absence of a pure counterfactual scenario, a simulation exercise is performed to obtain indicators of the intragenerational redistribution of life-cycle income associated with these public programs.

The net transfers received over the life cycle from the education system vary substantially by education level, with the more highly educated obtaining the highest net values. In contrast, those with the lowest levels of education are the ones that benefit most from the existence of a public pension system. The public programs reduce inequality for all education levels. Inequality levels are highest among the less educated and, paradoxically, redistribution is lower for those in this group. When decomposing the life-cycle income inequalities by income source, net public transfers in education have an equalizing contribution, while the contribution of pensions to life-cycle inequalities is proportional to their share in average income.

KEYWORDS: income inequality, welfare state, life-cycle, education, pensions

1. Introduction

The aim of the present study is to investigate the redistributive effects of the pension and education expenditure programs throughout the life cycle. The goal is to contribute to the drawing up of an informative map of inter and intra-generational exchanges and to understand the processes that generate them at both the micro and macro levels. Social and economic support networks between generations are one of the main pillars of the welfare state (Albertini, 2016; Künemund and Rein, 1999). Thus, within the social welfare system, those of working age provide the economic resources both for the young, in terms of family and school support, and for the elderly, in terms of pension and health financing. Such a system can be conceptualized not only as redistribution between age groups, but, from a life-cycle perspective, as intragenerational redistribution. These exchanges result from the extension of welfare state action over the last century from mere poverty reduction to broader programs for the provision of social goods (including, education and health) and programs that seek to secure a certain level of income (primarily, pensions and unemployment protection). In this process, the two main intergenerational income redistribution programs have been forged: public spending on education and the pension system. At the beginning of the 21st century, the social model founded on intergenerational transfers underpins the future development and sustainability of the European social model, given its need to adapt to demographic changes, the economic cycle, and shifting family cultures and values.

While the intergenerational redistribution components of education and pension programs are self-evident, their effects on income inequality within generations are uncertain and they are not among their primary objectives. Although pension programs are obviously designed as a social protection mechanism that should guarantee a decent level of income during old age (in this regard, see, for example, the European Commission's goals[1]), this objective is more about transferring income between generations than with ensuring low levels of inequality within the same age group. Thus, pension adequacy is usually measured in terms of the income level of the working population (replacement rates, and median or extreme income percentiles[2]).

In Spain, the public pension system represents the main component of the welfare state. In 2014, spending on pensions accounted for 10.5% of GDP, compared with an OECD average of 7.9%, with retirement pensions constituting the main expense at ca. 7.4% of GDP. The pension system is primarily contributory (although there are smaller non-contributory and means-based systems) and is organized on a pay-as-you-go basis. It includes pension benefits – retirement, disability and survivors – for those who meet eligibility requirements based on age and past contributions to the system. The intragenerational redistributive objectives are largely reserved for the non-contributory part of the system, which is concerned with ensuring a minimum level of income for those with short or no working careers.

Percentage spending on public education in relation to the GDP has been at values close to 4.5 since 1995, with few variations – for example, in 2015 it stood at 4.34%. Figure 1 shows the evolution in public education spending by level of education between 1942 and 2014. The rising trend in education expenditure can be seen for each

[1] European Commission. Social Protection Committee. *Pension Adequacy in the European Union 2010-2050*, 2012, vol. 7)

[2] See footnote 1

level, and it describes certain pro-cyclical patterns. This increasing trend coexists with the expansion in education that has occurred in recent decades (Figure 2).

Figure 1 here

Figure 2 here

Any discussion of the redistributive effects of education and pension programs acquires particular relevance in the context of population ageing and the shift of public resources to the elderly as observed in most welfare states (see, for example, Abio et al., 2015 and Patxot et al., 2012). The analysis of intragenerational inequalities from a life-cycle perspective can contribute to a better identification of the programs' winners and losers and, thus, complement the perspectives held by various generations seeking to obtain public resources. The age perspective would appear to identify children and young people as the losers in the processes of redistribution directly attributable to the ageing process and exacerbated by the economic crisis. The process of transferring resources to the elderly is a trend that was initiated several decades ago and is one that is observed in most welfare states. Fuchs and Reklis (1992), for example, showed that since 1960 public expenditure on adults had increased much more rapidly than spending on children in the United States. Even in northwestern Europe, with its more generous family support programs, single mothers and their children remain more vulnerable to poverty than any other groups (Smeeding et al., 1988). In Spain, Abio et al. (2015) estimate that, on average, people aged 65 and over finance more than 60% of their consumption with public transfers (mainly pensions, but also from other public programs such as health), while in the case of children (under the age of 19) this proportion is only 37%. The picture is not very different in other countries. In Sweden, for example, the elderly finance 144% of their consumption from public transfers – with long-term care representing a large component – while children finance only 44% (Abio et al, 2015). Figure 3 shows an international comparison of the average amount of both public and private transfers received by children (ages 0-19) and the elderly (65 and over)[3] obtained using the National Transfer Accounts (NTA) methodology[4]. As can be seen, older people receive more public transfers than children, for whom most of the intergenerational redistribution takes place through the family. In short, the welfare state where it exists, seems clearly unbalanced in favour of the elderly, and Spain is no exception.

Figure 3 here

In the current debate about the sustainability of the pension system and, more generally, that of welfare states as they have operated to date, information about the redistributive effects of education and pension programs can contribute to the design of an intervention framework that combines objectives of both sustainability and equity. This investigation aims to contribute to this debate by estimating the impact of public programs of education and pensions on the life-cycle income inequality of the cohorts of individuals born between 1955 and 1975. The main innovation in the present paper is that

[3] In line with the NTA methodology, to facilitate comparisons between economically very different countries, the magnitudes are usually expressed as a percentage of the country's average labor income between the ages of 30 to 49.

[4] See section 4 – Data and variables – for details and the NTA Project website: http://www.ntaccounts.org/web/nta/show/.

it takes a life-cycle approach to redistribution when considering both public education and pension programs. This requires information for the entire life cycle, especially as regards the net benefits received by the young (education) and elderly (pensions). As such, data availability is one of the main challenges in conducting this kind of analysis. More specifically, the paper makes two major contributions to the literature: first, its uses life-cycle microdata for a cohort of individuals that combine public expenditure on education by education level and cohort (computed as an individual's benefits); life-cycle labour income; and, pensions obtained using the Continuous Sample of Working Lives (Muestra Continua de Vidas Laborales – MCVL) and complemented by a dynamic microsimulation of pensions; and, second, it focuses on differences by level of education. People with different levels of education, and predictably different salaries, will receive different net transfers from education and pension programs. Their tax contributions are expected to be different, as are the benefits they receive in the form of income transfers (pensions) or in kind (education).

The rest of the paper is structured as follows: the next section presents the methodology, section three the data and methods, section four reports the results; and, finally, section five concludes.

2. Methodology

The methodology combines the use of indicators of inequality of life-cycle income with a decomposition of inequalities of life-cycle income and labour income in line with Shorrocks (1982). Life-cycle records are constructed using observed data on labour income and pensions from the MCVL and education transfers – by level of education and cohort – from different sources, and merging these with data obtained using dynamic microsimulation techniques.

The microsimulation process is undertaken using the pension model DyPeS, as used previously in Fernández-Díaz, Patxot & Souto (2013) and Patxot, Solé & Souto (2017). DyPeS is a dynamic micro-based model – meaning that it simulates micro units over time. It was developed to analyse the Spanish contributory pension system using ModGen, a generic dynamic microsimulation programming language designed and maintained by Statistics Canada and widely used in social science dynamic microsimulation.[5] This is complemented by imputing the cost of public education to each cohort.

The aim of using this strategy is to obtain indexes of inequality for a scenario with, and a scenario without, transfers for the cohorts of workers born between 1955 and 1975. In the first scenario, an individual's income includes their labour income and the net public transfers obtained from the education and pension system. In this way, it is possible to calculate a "life income" adjusted for these transfers using the following scheme: during their working life an individual's annual income includes their salary – from which taxes on education and social security contributions for pensions are deducted – and the benefits from the public education system, according to their level of education and year of birth. Finally, when people retire, they obtain a pension. The current values of each of these flows are calculated, that is, for education, pensions and wages. Finally, an adjusted income value per individual is obtained. In the second scenario – without public pension and education programs, an individual earns a wage and must cope individually with the costs of education and save for their pension. The young borrow to

[5] ModGen supports the creation, maintenance and documentation of most dynamic microsimulation model types, including both continuous and discrete time, case and time-based models as well as interacting and non-interacting populations. It is freely available at the Statistics Canada website.

invest in education and pay back when they start to work. Middle aged save for their pensions the same share of income as if they were contributing via public system[6].As explained below, we do not allow for any behavioural reactions; thus, education levels are kept unchanged in both scenarios, and the costs of education are assumed to be the same in both scenarios. With this exercise we capture the sole effects of the source of financing, and ignore the possibility that increasing public education spending per student may change the distribution of education levels among the population.

In a second step, we analyse life-cycle inequality using decomposition techniques. Following Shorrocks (1982), we first decompose the adjusted life-cycle income inequality (as described above) into the contributions made by different sources of income[7]. Shorrocks (1982) demonstrated that there was a unique 'decomposition rule' for which inequality in a certain variable across observations could be expressed as the sum of inequality contributions from each of the factor components. The proportion of total inequality contributed by factor k, $s_k(I)$, can be expressed as the covariance of this income source with total income (Y), scaled by the total variance of income[8]:

$$\mathrm{s_k(I)} = \mathrm{cov}\left[\mathrm{Y^k}, \mathrm{Y}\right]/\sigma^2(\mathrm{Y})$$

Factor components with a positive value for $s_k(I)$ make a dis-equalizing contribution to inequality in total adjusted life-cycle income; factor components with negative $s_k(I)$ values make an equalizing contribution. Shorrocks shows that the choice of the decomposition rule is independent of the index used to summarize inequality. When inequality is measured using the square of the coefficient of variation (a member of the generalized entropy class of inequality measures), total inequality can be written in terms of the factor correlations with total income, the factor shares in total income, and the factor inequalities, which provides an interesting intuitive interpretation of $s_k(I)$

$$cov[Y^k, Y] = \frac{1}{2}(C_k^A + C_k^B)$$

where

$$\mathrm{C_k^A} = \frac{\sigma^2(\mathrm{Y^k})}{\mu^2} \; ; \; \mathrm{C_k^B} = \frac{\sigma^2\left(\mathrm{Y^k}\right) + 2\mathrm{cov}(\mathrm{Y^k}, \mathrm{Y} - \mathrm{Y^k})}{\mu^2}$$

For life-cycle labour income, we decompose inequality into the contributions made by certain characteristics[9]. This exercise allows us to disentangle the specific role of education transfers on life-cycle income, through its contribution to labour income inequalities. Using the method set out by Fields (2003), we estimate an equation of the form

[6] Discount rates (in both public and private system) and interest rates are set at 3%.
[7] These calculations can be performed using the Stata package ineqfac (Jenkins, 1999).
[8] The same approach is taken by Jenkins (1995) and Brewer and Wren-Lewis (2016) to account for changes in income inequality in the UK.
[9] These calculations can be performed using the Stata package ineqrbd, written by Fiorio and Jenkins (2007).

$$y_i = \prod_{j=0}^{j=N} \beta_j X_{ij} + \epsilon_i$$

where $y_i = \ln(Y_i), Y_i$is the individual's income, $\left(X_{ij}\right)_{j\in[0,N]}$is a set of observed characteristics that we hypothesize influence life-cycle labour income (sex, education, length of working career, education transfers received and cohort) and $\in_i$is the residual term. The coefficients, β_j, are estimated by OLS, which allows us to obtain the residuals at the individual level and to perform the decomposition. This decomposition is the same as that described above (Shorrocks, 1982) if we treat each factor $\beta_j X_{ij}$and $\epsilon_i$as an income source. Then, the contribution of each characterisitic (j) to income inequality can be defined as

$$s_j(y) = cov\left[\hat{\beta}_j, X_{ij}, y\right]/\hat{\sigma}^2(y)$$

3. Data and variables

The microsimulation model DyPeS[10] uses as its starting sample the Muestra Continua de Vidas Laborales (MCVL). The MCVL combines administrative information from three sources – the census, the Social Security register and the tax records – and it contains a representative random sample of 4% of the population presenting Social Security records for each year – that is, it includes approximately 1,200,000 individuals for whom data are available about both their current and previous employment history, including their (gross) wages and benefits received. DyPeS starts from the 2007 wave of the MCVL, excluding self-employed workers as there is no enough information to simulate their future wages.[11]For the rest of the individuals needed for the simulation (future cohorts or young people who have not entered the labour market in 2007) their life is simulated from birth to death, through entry into the labour market, transitions between contribution groups, transitions to unemployment and retirement. This is done using demographic projections (e.g., life expectancy) published by the National Institute of Statistics of Spain or data observed in the MCVL from the starting subsample. The retirement event is modelled by estimating a survival model. The programming language for the simulation is Modgen, developed by Statistics Canada, which, broadly speaking, works as follows: it creates an event queue and calculates the time to the next event (using fixed probabilities or behaviour). Finally, when the event occurs, all times are revalued. The simulation allows wages to be obtained – and, therefore, contributions to the pension system and taxes allocated to education – and pensions for the period 2008-2060. Throughout the process, we assume that there will be no change in behaviour – what in microsimulation has been called "arithmetic microsimulation" (Bourguignon and Spadaro, 2006). The simulation data are combined with historical data (from 1980 to 2007) from the MCVL and a database is created for the period 1980–2060. In this way,

[10] The details of the assumptions of the microsimulation model can be found in http://www.ub.edu/school-economics/workingpapers/sustainability-adequacy-spanish-pension-system-2013-reform-microsimulation-analysis/ (section 4. Data and Assumptions)

[11] For a detailed description of the MCVL see MTAS (2006). Pérez-Salamero et al., (2017) undertook an evaluation of the representativeness of the MCVL.

the study period covers the entire working life of the individuals in the sample, as well as their old age, and several magnitudes can be obtained.

The historical series of wages up to 2008, the year in which the simulation begins, is obtained from the contribution bases of the MCVL. From 2008 onwards, wages are projected according to a model based on the traditional Mincer equation that includes as explanatory variables: previous wage, personal characteristics – age, age squared and migrant status; productivity indicators – education, qualification group and experience; business cycle indicators – unemployment rate; and cohort effects that are supposed, for the sake of simplicity, to be linear.

Taxes allocated to public education have been obtained combining information regarding the share of education expenditure over total public expenditure (OECD data), the share of each tax (direct and indirect) over total tax revenues, with national accounting data, and the share of each tax over individual labour income by education level, sex and age (taking the 2006 age structure as constant over time). Information on individual labour income and taxes by age, sex and education level is obtained from National Transfer Account data (Abió et al, 2017). The consideration of differences by education level on the tax rate applied to obtain taxes to education tries to reflect, to some degree, the progressivity of the tax system.

Expenditure on education to impute the benefit of the education system per individual requires information on the number of students and on public expenditure in each area. Student numbers are obtained from two sources: Statistics of teaching (INE publications) for school years 1963-64 to 1966-67 and 1969-70 to 1984-85. From 1986 onwards, these data are available online at the Ministry of Education and Science (also Statistics on Education). Data on public expenditure on education by education level from 1885 to 1965, with a gap between 1936 and 1940 (Civil War), are obtained from the Ministry of Finance[12] and Diebolt (2000)[13]. From 1965 to 1980, public expenditure is calculated using the yearly Public Administration Accounts, and from 1992 to the present, the data are available online at INE.

With the above information, expenditure profiles by age, education level and year (and, therefore, by cohort) are obtained (see Appendix 1 for details). Each student in the public system receives a transfer equal to the average cost of production of the service, according to their education level and year of birth. Similar assumptions are common in the literature (Smeeding et al., 1993; Jones, 2006; Marcial et al., 2006; Garfinkel et al., 2006). In the scenario in the absence of public transfers, it is assumed that students have to bear the education expenses themselves. The benefits of education have been imputed throughout the individual's working life, during the years in which their salary profile is increasing, taking as a reference the average worker.

Pensions are obtained by microsimulation, as the cohorts in the study will retire from the year 2024 onwards, approximately. DyPeS calculates incoming pensions and their updates as follows: individuals aged over 58 and fulfilling the eligibility conditions compute their retirement hazards monthly, and the covariates that determine the retirement decision are also updated monthly. In this computation, they consider possible retirement paths (anticipated, delayed, ordinary, etc.) and also weight their expected pensions by the probability of their being unemployed in future years. The variables affecting retirement hazards are those typically employed in the literature: age, individual productivity-related characteristics (such as education and experience) and the

[12] *Datos básicos para la historia financiera de España, 1885-1975*, vol. 2, Fábrica Nacional de Moneda y Timbre, Madrid, 1976

[13] Diebolt, C. (2000). Dépenses d'éducation et cycles économiques en Espagne aux 19ème et 20ème siècles. *L'Harmattan, Paris*. Diebot. 2000.

individual's performance in the labour market, time preferences and business cycle considerations (see Patxot, Solé & Souto, 2017, for details).

The proportion of workers' contributions (both workers' and employer's) allocated to retirement pensions in relation to labour income has been calculated by combining the information of individuals' contribution rates with the share of total contributions of the economy (excluding self-employees') for a given year allocated to retirement pensions. This has been done taking as reference a year with a budget balance close to zero (i.e., 2008).[14]

By combining the above information, it is possible to construct our variables of interest. The yearly net value of education is computed as the difference between the imputed benefit received from the public system (the average cost per level and cohort) and the share of labour income allocated to education in the form of taxes. Similarly, the yearly net value of pensions is calculated as the difference between contributions and pensions received. This allows us to compute net present values for education and pensions. By adding these magnitudes to the present value of wages, we obtain the "adjusted life-cycle income".

4. Results

The empirical strategy is conducted in two steps: first, the analysis based on the microsimulation results (section 4.1); and, second, a decomposition of income inequalities (4.2). These sections show the redistributive effects of the education and pensions expenditure programs throughout the life cycle, measuring the impact of such programs on the life-cycle income inequality of the cohorts of individuals born between 1955 and 1975. Policies aimed at raising the average level of schooling of a population have traditionally been seen as a mechanism for reducing wage inequalities, on the grounds that an increase in the proportion of workers earning high wages will result in a more equal distribution of income. However, the impact of these policies is ambiguous because the effects on inequality between education levels (predictably reduced with such policies) and those on inequality within each education level (for which the effects are ambiguous) are combined. Theoretical predictions concerning the relationship between educational expenditure and income inequality reflect this ambiguity (De Gregorio & Lee, 2002). Becker or Mincer's traditional human capital model predicts that wage distribution is determined by the distribution of education among the population. While the relationship between inequality (variance) in education and income inequality is clearly positive, the effects of an increase in the average level of education are unclear. Based on a similar logic, Knight and Sabot (1983) describe two opposite effects in the relationship between educational expansion and inequality: a "composition" effect associated with the growth of the highly educated group that increases inequality, and a "compression" effect of wages associated with the increase in the number of qualified persons and the consequent decrease in returns to education.

Empirical studies of the link between education levels and wage inequality also present ambiguous results. Martins and Pereira (2004) show that in most countries wage dispersion is higher among more educated individuals. Similar results are reported by Buchinsky (1994) for the USA, Gosling, Machin and Meghir (2000) for the United Kingdom, and Hartog, Pereira and Vieira (2001) for Portugal. Indeed, this evidence warns that educational expansion can actually increase overall wage inequality by increasing wage differentials within education groups. Yet, at the same time, the literature

[14] This calculations give the proportion of 17.86% of contributions (self-employed not included) allocated to retirement pensions.

supporting a positive link between public expenditure on education and a reduction in inequality is abundant, both at the international level (Callan et al., 2008; Garfinkel et al, 2006) and for specific countries (McLennan, 1996; Tsakloglou and Antoninis, 1999; Harris, 2000; Antoninis and Tsakloglou, 2001; Lakin, 2004).

Studies that adopt a life-cycle perspective are scarce. Crean (1975) identified the life-cycle nature of investment in education and the importance of the income redistribution flows that this generates. In the same decade, Lyard (1979) claimed education to be a more powerful redistributive mechanism than income transfers if taking a life-cycle perspective. Other, more recent, studies have criticized the primordial role given to education as an income equalization mechanism (Solga, 2014).

In Spain, it has been estimated that educational wage differentials contributed in accounting for the increase in wage inequality in the second half of the 1980s and the first part of the 1990s (Jimeno et al, 2000). More recently, Budria and Moro-Egido (2008) reported, in line with some of the studies cited above, that higher education is associated with greater wage dispersion. The incidence of a strong mismatch between qualifications and the job performed would account for the greater wage dispersion within education groups observed for Spain in recent years. Pijoan-Mas and Sánchez-Marcos (2010) point to the decline in the education premium and the high level of unemployment as causes of the downward trend in income inequality.

The use of pensions as an intragenerational redistribution device is, likewise, far from clear; despite the fact they were designed to have a role in this objective. However, various studies suggest that the degree of intragenerational redistribution of pension systems in many OECD countries has declined over the past two decades (see, for example, Krieger and Traub, 2008; Lindbeck and Persson 2003; Queisser, 2000; Werding, 2003). Bonenkamp (2009) assesses the inter- and intragenerational redistribution of the Dutch occupational pension system by taking a life-cycle approach. Redistribution is measured by sex, education level, and age in terms of the present value of the net benefit obtained from the system. The results indicate a considerable redistribution from workers with low levels of education to workers with higher education levels. From a life-cycle perspective, the impact of intergenerational transfers is modest. Nelissen (1995), a few years earlier, found that both vertical and horizontal redistribution, in the Netherlands, is considerably smaller when taking a life-cycle approach than when measured on the basis of a period approach.

4.1. Microsimulation results

This section describes the differences between the public and private financing of education and pension programs, as assessed from a comparison of two scenarios obtained from the microsimulation model: one in which the education and pension systems are public (as they currently are); the other in which each individual finances their own education and saves for their own retirement.

Public education spending may have an impact on life-cycle inequality through two direct mechanisms: the more educated receiving more transfers, but also paying more taxes to finance public education. Pension redistribution derives – as discussed above – from the interaction of different mechanisms of intragenerational redistribution: contributiveness, and minimum and maximum thresholds in pensions and contribution rates. Before conducting the analysis by education level, Figure 4 provides an overview by birth cohort of the weight of public transfers in proportion to life-cycle income. It shows a moderate increase in the share of educational transfers for those born between 1955 and 1966 and

the opposite trend (an increase of labour income) for younger cohorts, subtracting importance from the two public transfer programs (that is, education and pensions). Pensions represent around 5% for older cohorts and reduce their importance for younger cohorts, whereas net education transfers represent an increasing proportion of the total life-cycle income for younger cohorts (coinciding with the education expansion). .The importance of public education transfers on income might be also related to the transformation of the Spanish education system occurred in 1970. The Spanish education system have been regulated through different laws during the last decades. The generations born between 1955 and 1975 were affected by the Law 14/1970 of General Education and Financing of the Educational Reform (LGE). This reform regulated and structured, for the first time in that century, the entire Spanish education system. Among other measures, the law established the generalization of education from ages 6 to 14 for the entire population, in double sense: the integration in a single, non-discriminatory system of all children included in these ages, and full schooling (see Egido, 1995 for more details on the reforms of the Spanish education system). [15]

Figure 4 here

Figure 5 shows the net present values (NPV) of pensions, education and the present value of lifetime wages (PV), as well as income adjusted for transfers by education level ("Adjusted income"), according to the previous definitions. Noted that those present values are highly affected by discounting and the different age patters of transfers. Given that education transfers are received at the beginning and pensions at the end the lifecycle, the latter will be discounted more strongly. The Figure also highlights the relatively little weight of education for the lowest education levels, compared to its weight for higher educated Differences in the NPV of pensions (in the public system) by education level are opposite to the wage differences, which points to the equalizing role of pensions in the life-cycle income of individuals. Figure 6 plots the relative importance of education and pensions with respect to the total public transfers. Pensions represent the 85% of public transfers for the less educated, while this role is played by education transfers for people with university studies.

Figure 5 here

Figure 6 here

Figure 7 shows that the relative weight of net transfers received from the education system in proportion to the life-cycle income is higher for those at the higher education levels. The outcome is the opposite when individuals are grouped by adjusted private (work) income quintiles. Those with the lowest levels of income are the ones that receive, in proportion to their life-cycle income, the greatest benefits from the education system. This divergence is explained by the fact that the average income of those with the

[15] With respect to the nature and changes of the pension system, the relevant characteristics affecting inequalities will be discussed in the text. For a complete description of the pension system and the 2011 reform see Fernández-Díaz, Patxot & Souto (2013).

lowest education level is significantly higher than that of the lowest quintile, when we group by income. The relative proportion of pensions to life-cycle income is higher for the less educated and also for those with lower incomes.

Figure 7 here

The impact of public transfer programs on intragenerational income distribution can be approximated by comparing the inequality index of a scenario with public transfers to another in which individuals finance their own education and save for their retirement. Figure 8 shows the corresponding Gini indexes of life-cycle income by cohort and, as expected, financing the current levels of education and pensions privately would increase inequality. This is observed for all cohorts, despite the differences slightly decrease for younger cohorts. Figure 9 presents the Gini indexes for the PVs of private income and adjusted income by education level and cohort. With public programs, inequality is reduced at each education level, and the variation is notable if we consider that the variations in the Gini index values (typically computed annually) are usually small[16]. In both scenarios, the Gini values of the different educational levels tend to converge for younger cohorts. The main point to emerge from the analysis is that inequality levels are higher among the less educated and, paradoxically, redistribution is lower in this group. However, it should be noted that this exercise has been carried out without considering a complete counterfactual scenario, in which the distribution by education level would be altered by the presence of public expenditure on education, and that of the level of pensions by the public pension program.

Figure 8 here

Figure 9 here

4.2. Income inequality decomposition

This section shows the results of the decomposition of income inequality by income source, which gives a more accurate idea of the role played by public transfers on life-cycle income inequality.

An alternative way of assessing the role of public transfers on inequality involves decomposing life-cycle income inequality into the contributions made by the different sources. Table 1 presents the results of this decomposition, as described in section 3 – Methodology[17].

Table 1 here

Switching to a private system to finance education and pensions would lead to higher inequality levels (see results above), and pensions play a strong equalizing role (as suggested in Figure 5 and Figure 7). There are opposite forces driving the effect of public

[16] For example, the values of the Gini index in Spain rose from 0.324 in 2007 to 0.346 in 2013, during the crisis (OECD data), and the value in 2015 for Spain was 0.344 and 0.246 Iceland (the lowest one in the world)..

[17] Numbers in italics show the marginal effects of a 1% increase in each source of income on the Gini index of life-cycle income, computed using stata code written by López-Feldman (2006)

pensions on income inequality: On the one hand,he correlation between pensions and contributions (the "Bismarckian" part of the system) and, therefore, to labour income, would lead to reproduce de inequlity observed in the labour market. On the other hand, the existence of contribution and pension thresholds combined with the presence of minimum pensions, transform the pension system into an intragenerational redistribution device. . The net benefits of education have an equalizing effect on life-cycle income for all education levels and are slightly stronger for men. The positive effect of education spending on inequality when not disaggregating by education level can be related to the fact that the net values of education transfers actually reflect differences by education levels, which in turn affect labour income. Remarkable here is the strong dis-equalizing contribution of public education (when we do not disaggregate by education level) for women compared to men. Whereas labour income have a small equalizing contribution and eduction play the stronger dis-equalizing role for women, the contributions of education and labour income on iequalities are different for men: both labour income an education have a positive (dis-equalizing) contribution and the share of eduction is smaller than it is for women. The rationale underlying any factor decomposition requires that we examine each income component separately and neglect the feedback effects on other income sources (Shorrocks, 1982). The indirect effects of education transfers received (PV) and labour income may be substantial. However, their evaluation requires a specification of behavioural relationships that are avoided in factor decompositions of the kind reported here. For this reason, a second decomposition is performed, thus confirming the effects of education transfers on labour income inequality over the life cycle (see Table 2).

Figure 10 presents the evolution by cohort of the effects on inequality of the three income sources between 1955 and 1975. Notable here is the opposite trend of pensions and labour income and the increasingly equalizing role played by pensions during almost all the period (negative values represent equalizing contribution). The dis-equalizing contribution of education slightly increases up to 1965 and then falls, contrary to what we saw with wages. From this date, the increasing dis-equalizing role of labour income is compensated by the increasing equalizing role of public transfers. These trends run parallel to the evolution of the share of each income source in mean income (Figure 4), but are more pronounced. Finally, it should be noted that net pensions (benefits less contributions) received over the life cycle can be negative (ca. 13% of individuals present negative values). This can occur simply because the flow of contributions is higher than the pensions received (for different reasons) and also ecause in the Spanish system a worker has to have completed a minimum period of contributions to be entitled to a retirement pension. This accentuates the unequal nature of this source of income. This could hypothetically happen with education but, in practice, taxes allocated to education represent a smaller proportion of the income and individuals receive some positive flows in some degree, so negative net values of education transfers are rare (ca. 0.5%).

Figure 10 here

Table 2 presents the results of decomposing life-cycle labour income inequalities by a set of worker characteristics: sex, length of working careers, education and education net transfers. We use the regression-based methodology employed by Felds (2003) and Shorrocks (1982) and outlined here in section 3 – Methodology. This enables the effects of all the characteristics to be analysed simultaneously and identifies which specific characteristics contribute most in accounting for the inequalities. The first line shows the

contribution of the 'residual', that is, the part of inequality unexplained by the characteristics in the regression.

Table 2 here

As usual in decompositions of this kind, the residual accounts for a large share of the inequalities (36%). Among the explanatory variables, having a university degree is the variable that explains the greatest share of labour income inequality. This decomposition confirms the equalizing role of education transfers, which means that increases in net benefits per student (increases in education quality) of the public education system reduces labour income inequality over the life cycle. Labour income wage differentials by sex are substantial, and accordingly, their contribution in accounting for life-cycle wage differentials is also important (12%). Finally, length of working career contributes positively (3%) to labour income inequalities. Contrary to what observed for life-cycle income, education has an increasing equalizing role in labour-income inequalities for the oldest cohorts up to 1964. Then the trend is reversed and educationloses this positive contribution for more recent cohorts (1971 and above). This can be observed in Figure 11, which presents the contribution of education net transfers to life-cycle wage labour inequalities by cohort.

5. Conclusions

This paper has addressed the distributional effects of the two main programs of public transfers in Spain: education and pensions. To achieve this goal, the paper provided new data and approach: first, it reconstructed the life-cycle for some cohort of individuals at the micro level. In particular, it combined life-cycle labour income and public transfers in form of education and simulated pensions using data form the Continuous Sample of Working Lives (Muestra Continua de Vidas Laborales – MCVL) and dynamic pensions microsimulation model. Second, it focused on differences by level of education. A first exercise involved constructing a scenario "as if" these public transfers did not exist using microsimulation techniques. Second, decomposition by income source provided a picture of the contribution made by pensions, labour income and education benefits to life-cycle income inequalities, being the sum of three effects: their correlation with total income; their share in total income; and, their own inequality. Additionally, decomposition by worker characteristics sought to disentangle the role played by education transfers on life-cycle income inequality, an effect that is mediated by the impact of education transfers on labour income.

The analysis based on the microsimulation results shows that, for the less educated group, the net value of education transfers, when considering the whole life cycle, is very low. In contrast, this group is the most favoured by the existence of a pension system such as the one currently operated in Spain. Despite the sizable differences in net education transfers by education level, the differences by income level are quite distinct. Lower income quintiles receive a higher proportion of their income in the form of public transfers, above all, from the public pension system. Income inequality decompositions confirm the equalizing role of net education transfers, but only within each education level. Here the changing trends in the effects of education expenditure on inequality, parallel to the education expansion, are remarkable. The public education system has thus gained an equalizing role until the mid-sixties, while wages have increased their contribution to inequality if we consider the whole period (with a break in

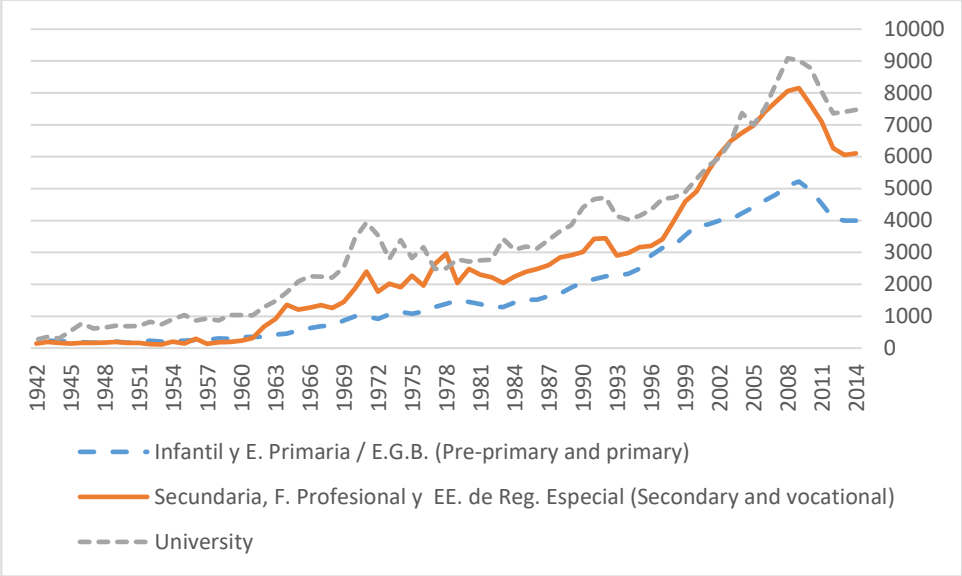
the trend during the late sixties). When considering the effect of education transfers on labour income inequalities over the life cycle at the same time as the level of education, its equalizing effect is maintained. But when separating the analysis of labour income inequalities by cohort, differences in net transfers received by the same education level have a dis-equalizing role in labour income inequalities for younger cohorts (those born between 1971 and 1975).

The proportion of pensions to life-cycle strongly varies among income and education groups. Pensions represent more than 20% of life-cycle income for those with lower income and ca. 11% for those less educated. For this group, net pensions represent more than 80% of public transfers (education transfers for this group are small). By contrast, the share of net pensions to life-cycle income for those more educated is less than 4%. Pensions make a slightly higher contribution to reduce income inequality when decomposing by source. On average, pensions contribute 5.8% to reduce life-cycle income inequalities in the case of women, this share decreasing to 4.08% in the case of men. All these results indicate a significant redistributive effect of pensions and, in this respect, it is worth considering the extent to which the pension system should be used as an intragenerational redistribution mechanism. As in many other countries, the pension system in Spain was designed along the lines of the Bismarckian (contributory) system, although some form of income redistribution was introduced from the outset, both in the form of nonlinearities with the Bismarckian parameters, and with the addition of contribution and pension thresholds. The reforms made to the Spanish pension system until 2011 have served to strengthen the Bismarckian nature of the system. Measures of this kind should – a priori – be producing less redistribution. However, it transpires that Bismarckian pension reforms do not always result in less redistributive outcomes in a pay-as-you-go system. In the current debate about the sustainability of the pension system and, more generally, about the welfare state, information on the redistributive effects of these programs can contribute to the design of policies that integrate objectives of both sustainability and equity.

Redistributive effects of public education and pensions over the life cycle

Tables and figures

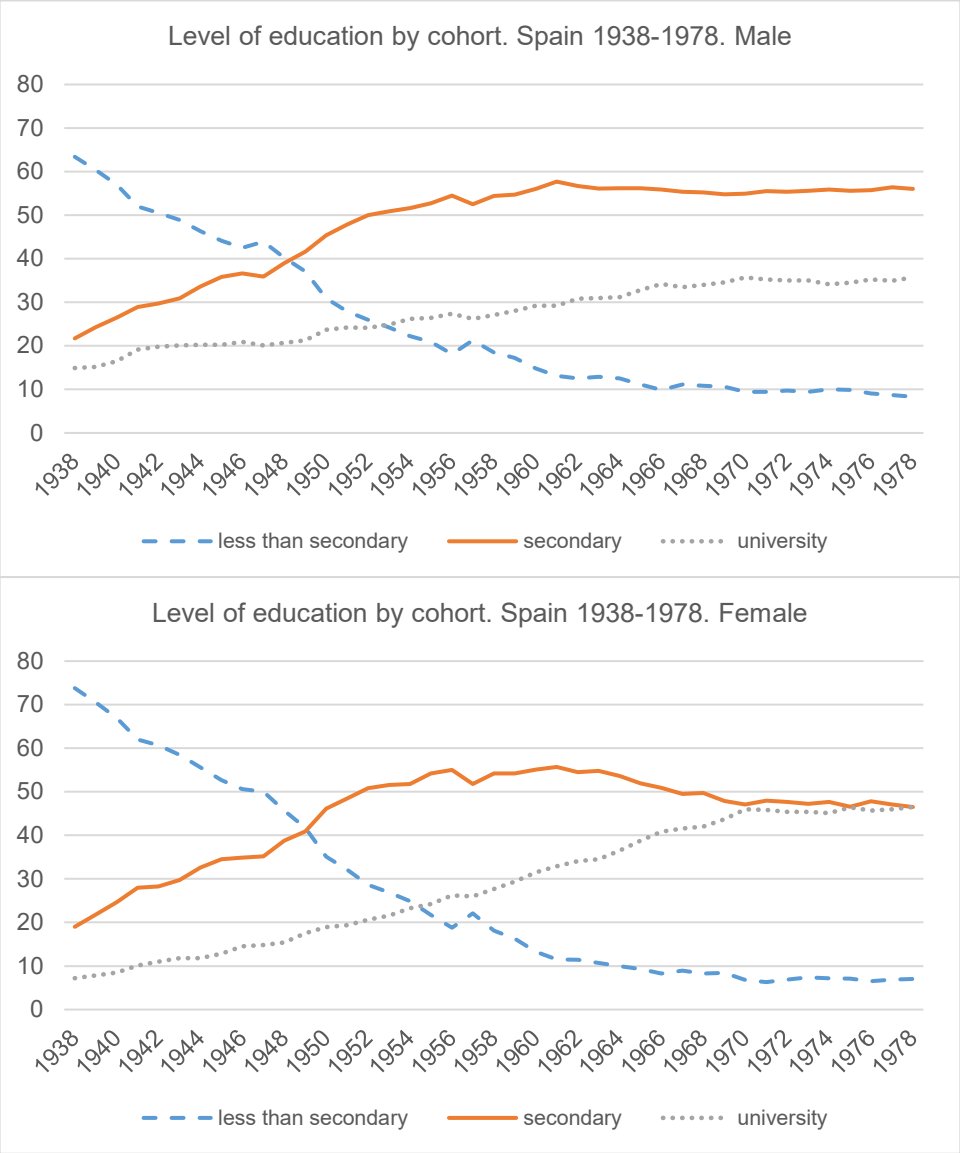
Figure 1. Public education spending per student by level of education. 1942-2015*



*2007 prices

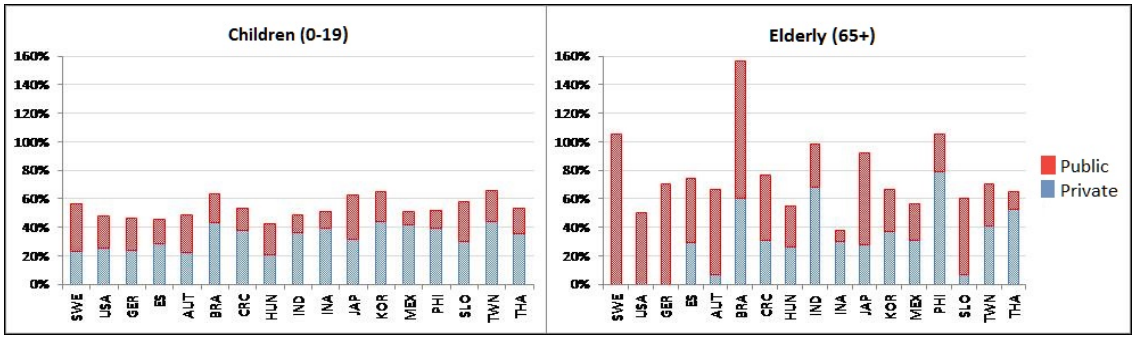
Source: author's elaboration (See section 4 – Data and variables – for details)

Figure 2. Educational attainment by gender



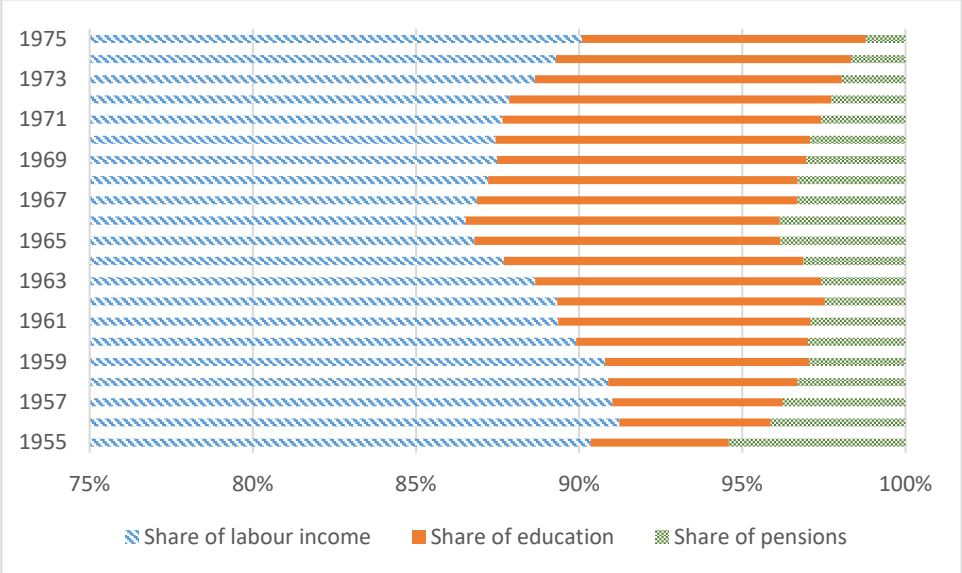
Source: Based on data from MEC (*Estadísticas de nivel educativo*).

Figure 3. Transfers to children and the elderly (as a percentage of the average labour income of people aged 30-49) by country



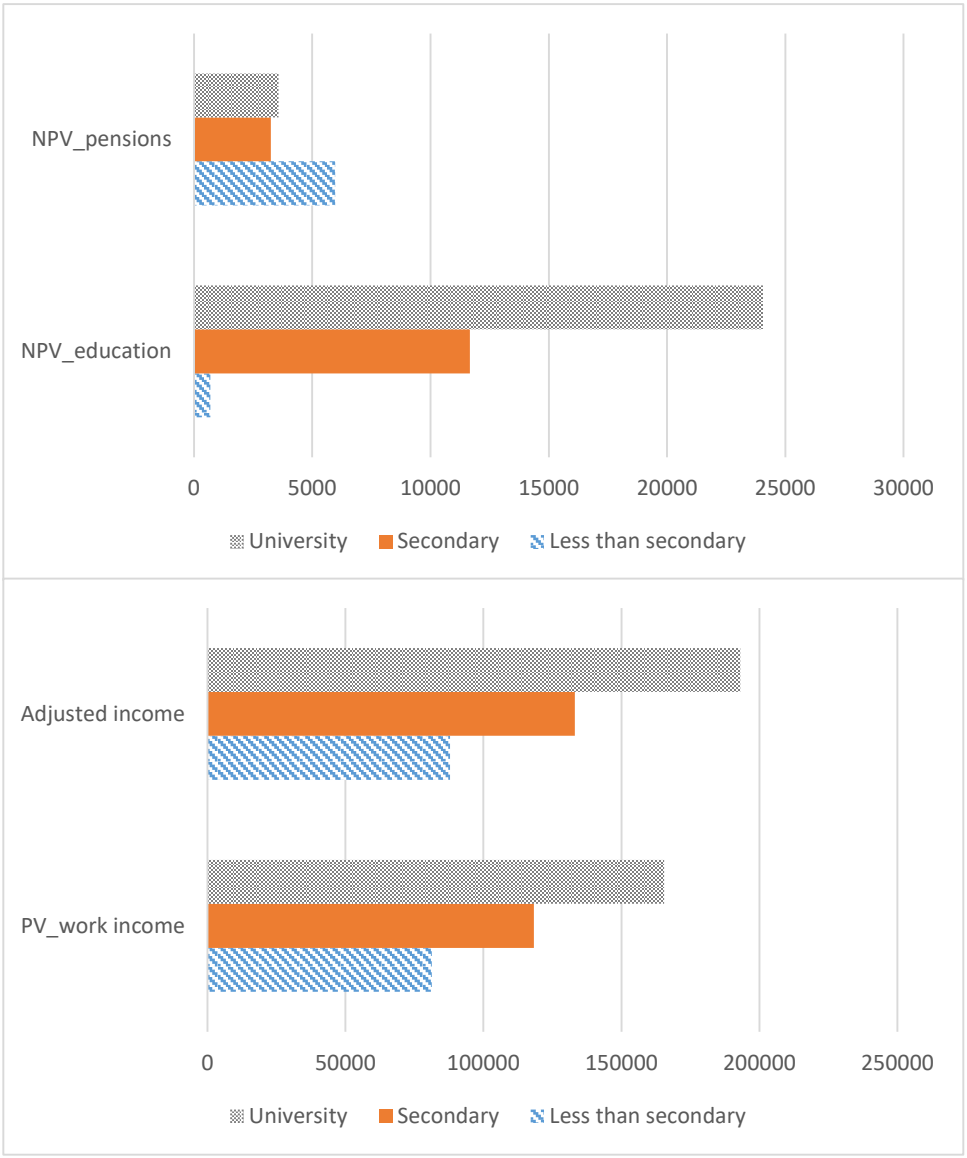
Source: Abio et al. (2015). Time period: 1996 (Brazil), 1998 (Taiwan). 1999 (Philippines), 2000 (Austria, South Korea, Spain and Thailand), 2003 (Germany, Sweden and USA), 2004 (Costa Rica, India, Japan, Mexico, Slovenia) and 2005 (Hungary, Indonesia).

Figure 4. Share of private income (salaries) and public transfers to adjusted life-cycle income. Cohorts 1955-1975



Source: author's elaboration

Figure 5.Net present values of transfers and adjusted income by education level



Source: author's elaboration

Figure 6. Share of transfers (NPV) to total public transfers by education level

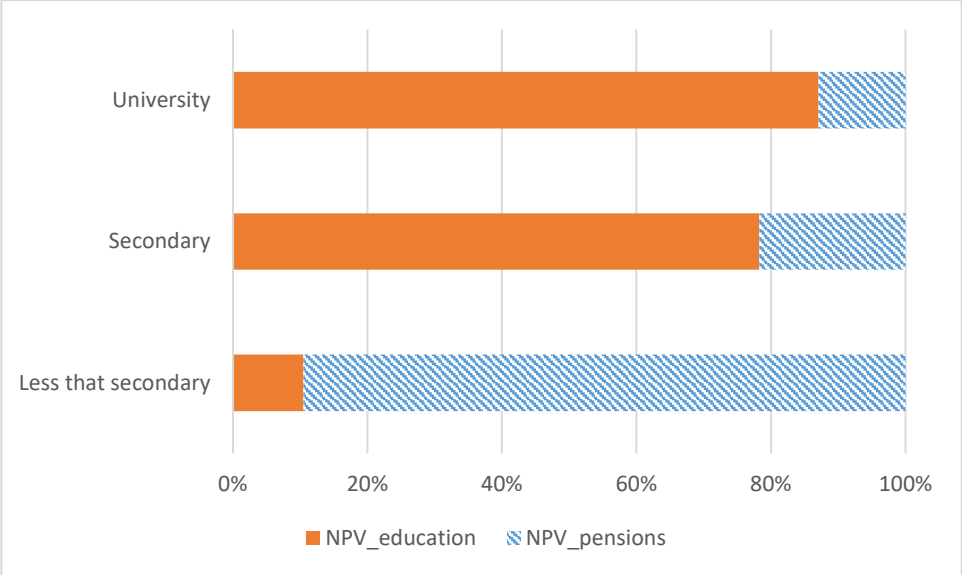
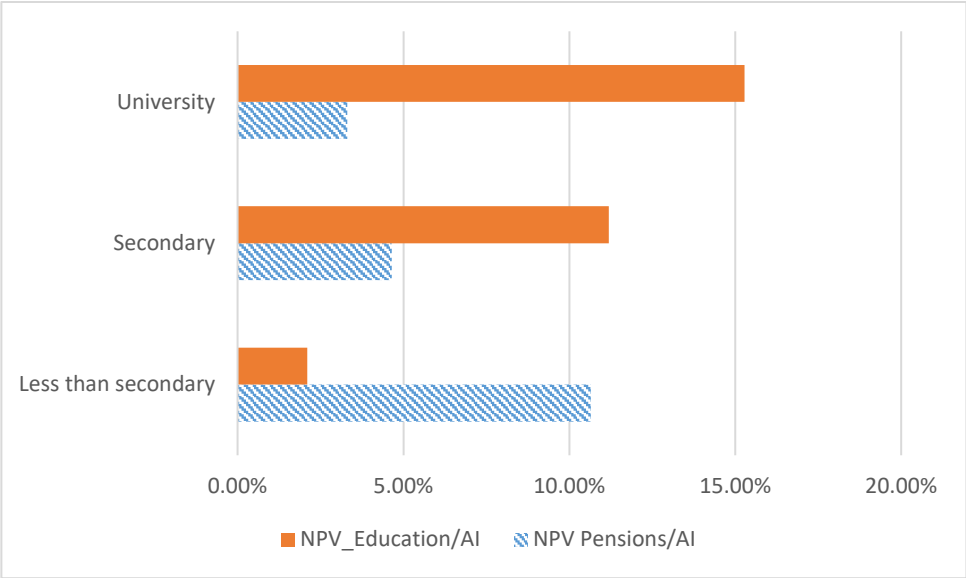
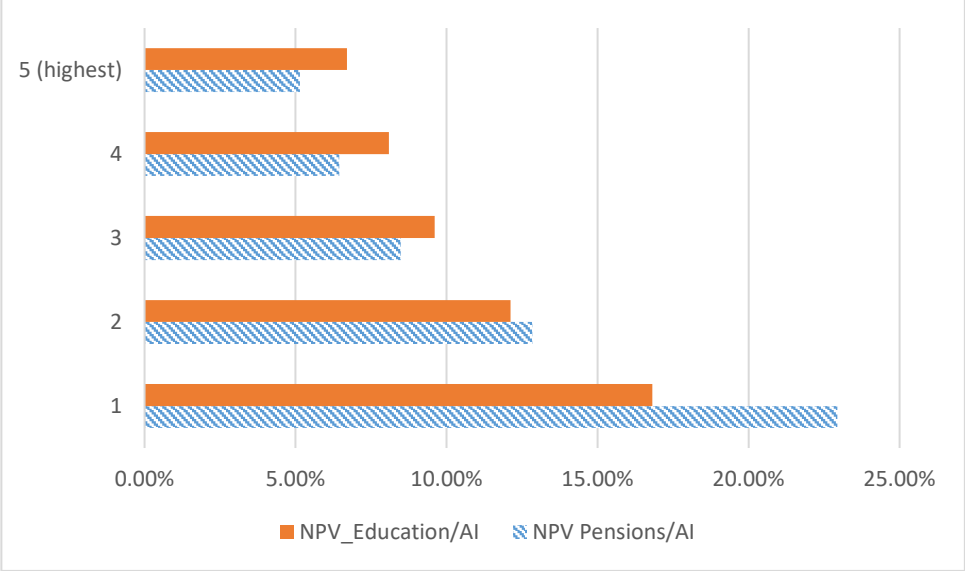


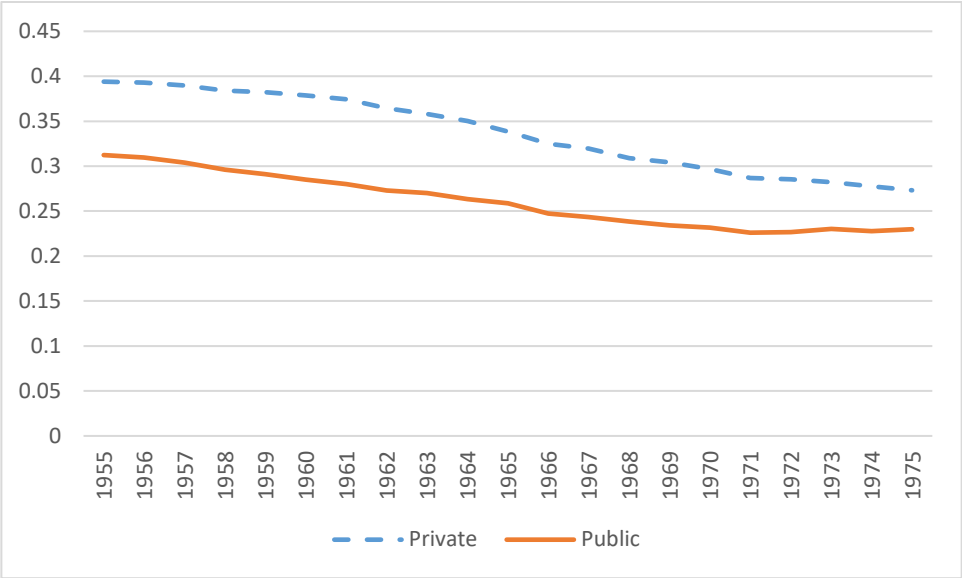
Figure 7. Share of transfers (NPV) to adjusted income (AI) by education level and income quintile





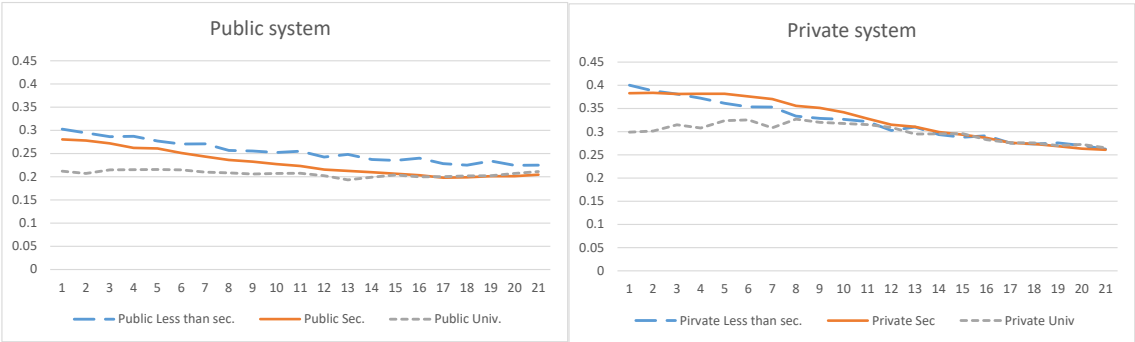
Source: author's elaboration

Figure 8. Gini indexes by cohort of the life cycle income. Public versus private financing of education and pensions



Source: author's elaboration

Figure 9. Gini indexes by cohort and education of the life cycle income. Public versus private financing of education and pensions

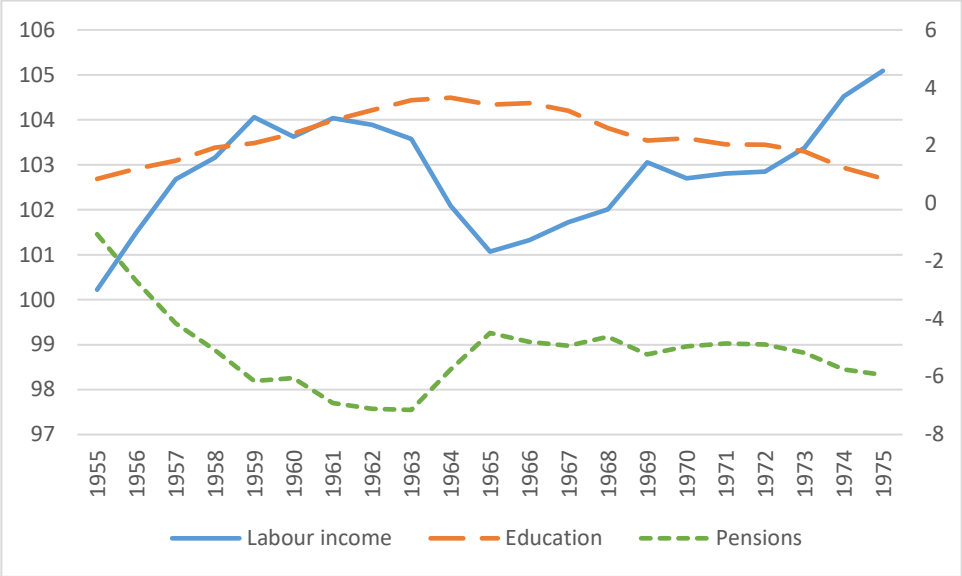


Source: author's elaboration

Table 1. Decomposition of life-cycle inequality by income source (dependent variable: life-cycle adjusted income)

	Male			Female			All		
	Net labour income	**Education (present value of transfers)**	**Pensions (present value of transfers)**	**Net labour income**	**Education (present value of transfers)**	**Pensions (present value of transfers)**	**Net labour income**	**Education (present value of transfers)**	**Pensions (present value of transfers)**
Share of income inequality (%)									
All	100.466	3.6186	-4.0846	99.7939	6.0199	-5.8138	101.9563	3.1356	-5.0919
	0.0921	*-0.0325*	*-0.0596*	*0.161*	*-0.0557*	*-0.1053*	*0.1393*	*-0.0564*	*-0.0829*
Less than secondary studies	108.9011	-3.5043	-5.3967	106.9362	-2.7218	-4.2144	109.7379	-3.47	-6.2678
	0.1202	*-0.0328*	*-0.0874*	*0.2046*	*-0.0452*	*-0.1594*	*0.1671*	*-0.0405*	*-0.1266*
Secondary studies	109.6227	-3.2208	-6.402	108.5584	-1.9731	-6.5854	109.9164	-2.8949	-7.0214
	0.1684	*-0.1012*	*-0.0672*	*0.2433*	*-0.1298*	*-0.1135*	*0.21*	*-0.115*	*-0.0951*
University	107.5234	-2.3285	-5.1949	107.4483	-2.0099	-5.4384	106.4696	-2.7273	-3.7423
	0.1857	*-0.1215*	*-0.0642*	*0.2458*	*-0.1745*	*-0.0713*	*0.2111*	*-0.1524*	*-0.0588*

Figure 10. Share of inequality by adjusted life-cycle income source and cohort*



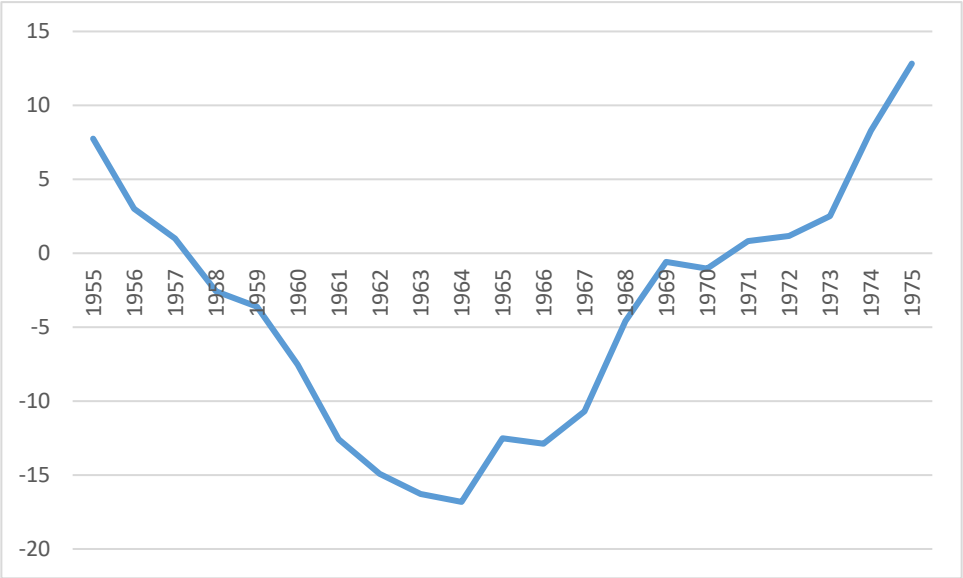
*contributions of education in the secondary axis.

Source: author's elaboration

Table 2. Share of characteristics in life-cycle labour income inequalities Dependent variable: labour income (%)*

Residual	36.1566
Sex	12.9245
Lenght of working careers	3.2522
Secondary studies	-3.4045
University studies	57.1936
Net education transfers	-9.0036
*We have controlled by cohort	

Figure 11. Contribution of education transfers on life-cycle labour income inequality by cohort*



*positive values mean dis-equalizing effect
Source: author's elaboration

Appendix 1. Education transfers profiles

The annual information on educational expenditure and number of students is combined with data by age to obtain the profiles of spending. By the 1960s, until 1967, there is information of number of students by age and it can be differentiated by public schools (national, official, government, etc.). In that case, this information has been incorporated into the profile directly. For those profiles where there is no information on age, the aggregate (if it exists) is used and the profile of the total number of students is applied. For those disciplines such as art, where there is no differentiated information between public and private, the total profile is used or, if this information exists in upcoming courses, the percentage distribution of that year is used and applied to the total number of students. In some courses, the information for the first age group is aggregated information (eg number of pupils below 6 in primary school, "EGB"). In these cases we tried to distribute these students between the corresponding ages using profiles of upcoming courses to avoid artificial peaks.

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