Ageing Europe – An Application of National Transfer Accounts for Explaining and Projecting Trends in Public Finances

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1. Introduction

It is widely acknowledged that population ageing poses a challenge to public programmes of the welfare state by exerting severe fiscal pressure on their sustainability. The strength of this pressure depends on a characteristic of welfare states that has been overlooked for a long time: namely, the extent to which the welfare state is directed towards the two stages of dependency observed during the lifecycle of individuals (children and the elderly). Indeed, an upward transfer system (from younger to older ages, like the pension system) would suffer from lower returns as population ages, while the opposite would be true for downward transfers (from older to younger ages, like education).

The three main pillars of the welfare state are pensions, education and health. Over the course of the twentieth century, most European countries have introduced public pension systems running on a pay-as-you-go (PAYG) basis and financed through payroll taxes, while public education and health care systems are mostly financed by general taxes, usually also in a (non-explicit) PAYG manner. Since most tax payments are concentrated at working ages, the rapid ageing of the European population might have harmful consequences for the long-term viability of these programmes as long as they are not balanced from an intertemporal or long-term point of view. This is due to the fact that the age shape of benefits promised to the population do not necessarily correspond to those of the expected revenues from tax receipts.

This deliverable aims at measuring the sustainability of the public budget for three selected countries (Austria, France and Spain) in face of ageing. To that end, we apply the model developed in the AGENTA project described in Deliverable 5.5 (Sánchez-Romero et al. 2017) in order to make projections of the impact of population ageing on the welfare state under different policy reform scenarios. By using historical data on National Accounts, the model allows us to evaluate the long-term viability of welfare state transfers in face of ageing and its impact on the subsequent generations.

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Gal and Monostori (2014), in Deliverable 6.1 of this project, revise the different taxonomies of sustainability indicators. Following the literature, they distinguish between cross-sectional and long-term (or intertemporal) indicators. The former refer to the indicators relating variables (mainly taxes and benefits) of the same year, while the latter refer to those that consider variables of many periods. In fact, in many cases these authors refer to intertemporal forward-looking indicators, while others referring to the past (like current debt, reflecting the past evolution of the budget balance) are left aside.

The cross-sectional indicators go from the purely demographic dependency ratio to other indicators including economic variables like the support ratio, or the annual budget balance of the government.[1] Among the long-term forward-looking indicators, the main distinctions are if they refer to a cohort's completed (or observed) lifecycle, or to the whole population. The former try to capture the net contribution of each generation to the public coffers by comparing the present value of benefits received and taxes paid (or, from the perspective of the cohort, the net return they receive). This allows evaluating how fair the public policy among different generations is. The latter combine these measures of cohort contribution with their size in the total population to measure the intertemporal sustainability of public finances. A measure that synthetises all the preceding is the intertemporal budget constraint of the government, which takes into account not only the past explicit debt, but also the future implicit (and perhaps unfunded) compromises with current and future generations. A clear example is the social security wealth (debt), i.e. the implicit wealth (debt) accumulated by a PAYG pensions system. When referring to the whole public budget, the outstanding example is the sustainability gap indicator, measured in generational accounting as the residual in the intertemporal budget constraint of the government: The part of current plus foreseeable debt that is not covered by foreseeable taxes (see

[1] They also refer to other more specific parametric characterization like duration, average ages or Lee's arrows. See Lee (1994) extended in Patxot et al. (2011).

Bonin 2001). This kind of indicators can then be translated into necessary tax or transfer adjustments (like the tax gap indicator).

Bommier and Lee (2003) discuss a similar accounting scheme, in the framework of an Overlapping Generations (OLG) model with realistic demography, to examine the dynamic link between cross-sectional and longitudinal accounts. From a lifecycle perspective, they define the present value of expectation of net receipt at birth in a given year for a transfer system as the survival-weighted discounted sum of benefits received minus taxes paid at each age for the generation born in that particular year during its entire lifecycle. If the present value equals zero for every birth cohort, the transfer system is said to be lifecycle balanced. From a cross-sectional perspective, they define the population-weighted average flow of a transfer system in a given year as the sum at each age of the net benefits received from the transfer system by all individuals of that age divided by the size of population in the corresponding year. If the average flow is equal to zero for every year, it is said to be population balanced, indicating that all the flows of that transfer system aggregate to zero at any time. This is the case of a pure balanced PAYG system.

In this paper, we apply an OLG model à la Auerbach and Kotlikoff (1987) with realistic demography that allows us to gauge the impact of the demographic transition on the sustainability of the welfare state. Starting from the historical reconstruction of past National Accounts, we assess its incidence in each cohort. To do so, we construct a complete age-time matrix of benefits and taxes for each year and birth cohort and analyse it both from a cross-sectional and from a longitudinal point of view. On the one hand, the model allows us to trace the annual evolution of expenditures affected by the age structure of population, taking into account the past historical evolution of transfers and the expected future evolution of population. The latter affects the tax levels that are required to balance the public budget every year. A priori, the model could allow the consideration of public debt, but we keep a balanced PAYG system in order to stress the demographic dependence of expenditures and taxes. This way the model captures the annual future tax adjustments that are necessary in order to

meet the projected increase in expenditure produced by ageing. Hence, we gauge the sustainability of the overall public finances by obtaining a cross-sectional annual version of the tax gap indicator (Section 2).

On the other hand, from a cohort perspective, we follow Bommier et al. (2010) and compute the present value at birth of the net benefits received from the welfare state programmes as a share of lifetime labour income. [2] We can evaluate the intergenerational fairness of public fiscal policy by comparing this value for past cohorts –for whom we observe their entire life cycle— to that for currently living and future cohorts who will be affected by the tax adjustments during the retirement of baby boomers (Section 3).

In Section 4, we assess the effects of several reform scenarios on the welfare state's sustainability and the intergenerational redistribution implied by public fiscal policy. In particular, we simulate the impact of delaying the retirement age and the impact of modifying the tax base for health care expenditure. We also look at the effects of a change in the educational attainment of the population. Finally, Section 5 concludes.

2. Sustainability of welfare state programmes

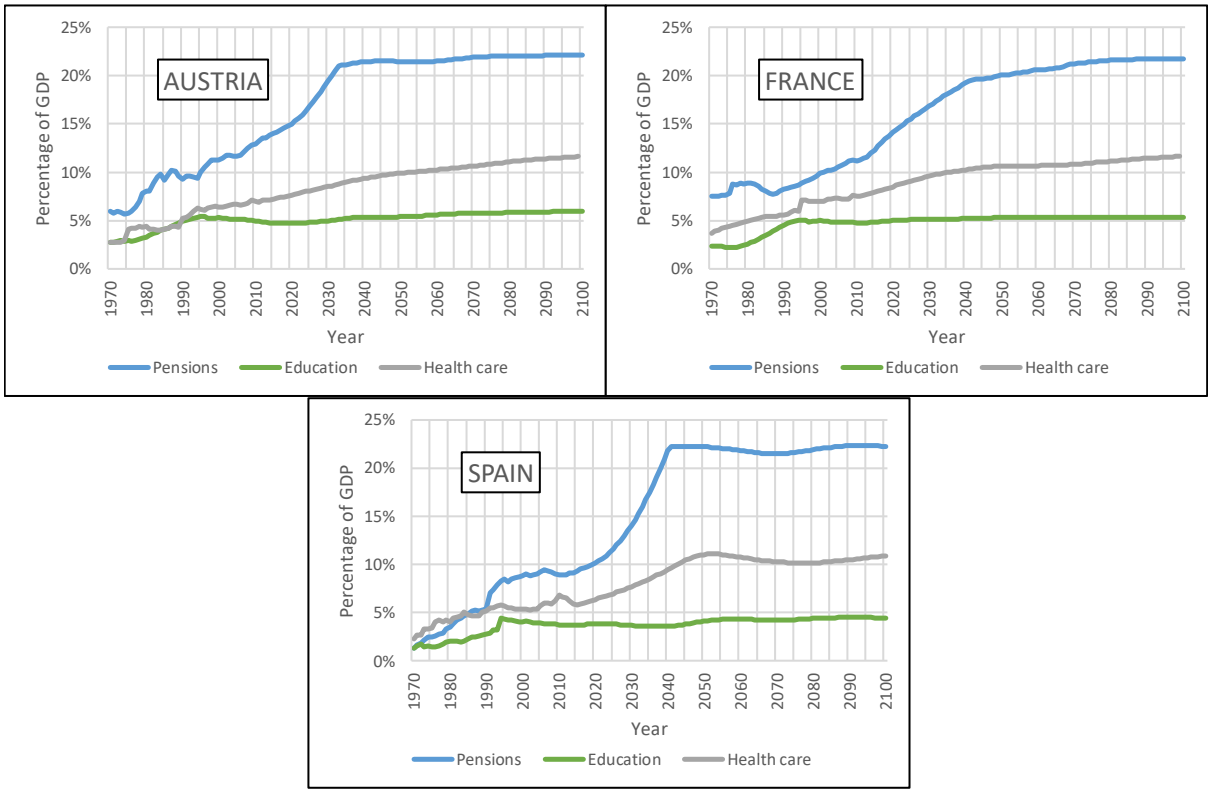
In this section, we focus on cross-sectional indicators. In particular, we analyse the annual evolution of public benefits obtained by combining NTA profiles with the observed historical aggregates of public expenditure, and the necessary tax adjustments to achieve an annual balance of a PAYG budget constraint.

Figure 1 shows the evolution (for 1970-2015) and the projected evolution of the ratio of public expenditures to GDP in Austria, France and Spain for the twenty-first century. The three main welfare state programmes (pensions, education and health care) are expected to account for a larger part of resources as population ages. In all countries, the most prominent increase corresponds to pensions, which

[2] In this case, the authors work in a partial equilibrium setting.

represents more than one fifth of GDP once the baby boom generation has reached retirement ages. In fact, as it is modelled (see Deliverable 5.5), social security contributions adjust each year to guarantee that the level of pension benefits is maintained for all retired individuals, but a maximum of 35% is set for the contribution tax rate. Hence, after reaching this value, benefits are adjusted downwards in order to balance the budget. This prevents the share of pensions to GDP to attain even larger values in the second half of the century. Health care expenditures are also projected to more than double as a share of GDP in the three countries, reaching a value around 11-12%. The other main pillar of the welfare state, education, experiences little variation along the twenty-first century and amounts to roughly 5-6% of GDP, being slightly lower in Spain.

Figure 1. Public expenditures as a share of GDP in Austria, France and Spain.



Not surprisingly, the programmes consisting of transfers that go to the elderly are the ones that are expected to grow, relative to the national income, as population ages. In the case of health care, the age profiles of this type of expenditure are J-

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shaped in the three countries considered (see Figure 10 in Deliverable 5.5). The fact that the young dependency ratio is projected to shrink as the old dependency ratio rises reinforces the predominance of total expenditure at higher ages so that the resulting budget is increasing as a consequence of the demographic transition.[3] For education, the full unfolding of the educational transition somehow compensates the decline in the number of children and the weight of this programme remains rather constant over time.

As explained in Deliverable 5.5, it is assumed that all public programmes are financed through a balanced PAYG system. Apart from the pension system's budget constraint, there is another government budget constraint relating other expenditures to consumption, capital income and labour income taxes. Although it would seem more realistic to account for the possibility of public debt and introduce it into the model by considering the government's intertemporal budget constraint, here we stress the demographic dependency of expenditures by imposing an annually balanced system in all programmes. Table 1 shows the weight of each programme of public expenditure and the value of the different tax rates needed to balance their budget at three moments in time for the three countries considered, namely in year 2015, 30 years before (1985) when ageing was merely incipient and 30 years after (2045) when the ageing process is fully spread out into the economy.

The figures in Table 1 highlight the fact that the welfare state was developed later in Spain than in the other two countries. Thereby the Spanish shares of pension and education expenditures in 1985 are lower than the Austrian and French shares (4.9 and 2.3 in Spain versus 9.1 and 4.1 in Austria and 8.0 and 3.4 for France respectively). These differences tend to shrink by 2015 and reverse by 2045 in the case of pensions, as a result of a more drastic ageing process in the case of Spain and despite a lower level of benefits (see Figure 13 in Deliverable 5.5).

[3] Quite interestingly, the NTA estimates permit to see that transfers to the old exceed those to the children even in per capita terms in most countries (see Patxot et al. 2011 and Abío et al. 2015).

Moreover, the Spanish educational transition started later and is projected to continue until the late decades of the twenty-first century, which explains the still comparatively low value for education in 2045 for this country. With respect to health care, Austria is the country with the lowest figures in the initial and final years considered. This is mainly because of a lower level of public health benefits, relative to labour income, in the Austrian age profile (see Figure 10 in Deliverable 5.5).

Table 1. Share of public expenditures to GDP and tax rates in Austria (AUT), France (FRA) and Spain (ESP).

	YEAR	1985			2015			2045		
	COUNTRY	AUT	FRA	ESP	AUT	FRA	ESP	AUT	FRA	ESP
Public Expen-diture to GDP (%)	Pensions	9.1	8.0	4.9	14.0	12.3	9.3	21.5	19.7	22.2
	Education	4.1	3.4	2.3	4.7	4.8	3.7	5.4	5.3	3.8
	Health	4.0	5.4	4.8	7.2	7.9	5.9	9.6	10.5	10.5
	Other	8.8	11.5	6.2	6.3	8.9	8.3	6.2	8.6	8.2
Tax rate (%)	Social Sec. contributions	17.6	15.4	7.6	25.3	21.5	14.7	35.0	33.0	35.0
	Consumption	14.2	18.2	9.7	14.0	19.2	12.6	17.2	23.3	17.6
	Capital income	15.7	20.0	18.2	16.2	28.4	31.3	17.9	29.2	35.9
	Labour income	10.4	12.1	7.4	12.7	12.0	9.4	15.0	13.9	12.0

Regarding tax rates, to derive the figures in Table 1 we assume that the tax mix applied in the baseline to fund government consumption is held constant thereafter. In the case of social security contributions, differences between the three countries in 1985 again reflect the distinct stages of development of the pension system at that point in time, with Spanish contributions at less than half the level of the other countries. By 2045, and as a result of the modelling assumptions, social security contributions attain the upper limit of 35% in Austria and Spain (specifically, this limit is reached in 2034 in the former country and in

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2041 in the latter) while France is still below it (until 2069) due to a less severe ageing process. Consumption and labour income taxes are systematically lower in Spain in 1985 and 2015, but in the case of the consumption tax, this is not true anymore in 2045 due to the more severe necessary adjustments in face of ageing in this country. The capital income tax rate, on the contrary, is the highest in Spain for most part of the period, and is always the lowest in Austria. In Section 4.2 the effects of changing the tax bases in the future is discussed.[4]

Nevertheless, the rise in tax rates reported in Table 1 that all countries are projected to experience as ageing phases in the economy is a measure of the unsustainability of current public expenditure programmes, as these transfer systems would become unsustainable if tax rates remained constant. The next section shows how these tax adjustments are projected to hit different generations.

3. Cohort analysis

In this section, we assess the intergenerational impact of public transfers by measuring the financial redistributions implied by the public pensions, education and health systems. To do so, we take a longitudinal perspective of our data and calculate the lifetime-discounted survival-weighted benefits received and the lifetime-discounted survival-weighted taxes paid during the lifetime of each generation born from 1900 until 2100. The difference between these two figures is referred to as the net present value at birth of the transfer system. If this value is zero, the transfer system is actuarially fair. If it is the same for all birth cohorts, it means that the system does not imply any intergenerational redistribution. We first compute the net present value at birth for each public programme separately and then for pensions, education and health care altogether. These present values are expressed relative to the present value of survival-weighted lifetime earnings, as is standard in this methodology, easing international comparisons.

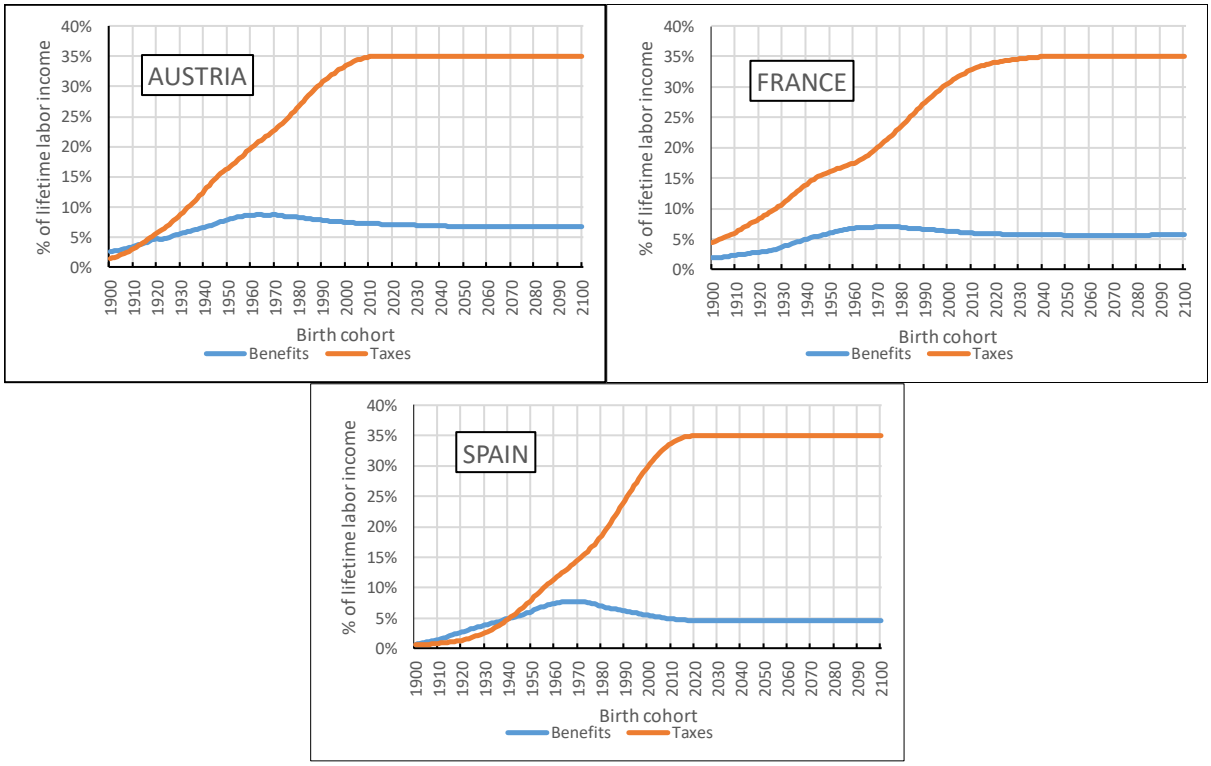
[4] Deliverable 5.5 discusses the effects of these tax increases on capital and output.

Figure 2 shows the present value at birth of pension benefits and taxes for cohorts born during the twenty-first century in Austria, France and Spain. The three countries exhibit similar patterns for both series, taxes reaching much higher values than benefits and the gap between the two widening as we consider cohorts born further in the future. In France, this difference is always negative, meaning that all generations have paid or are expected to pay more than they have received or are expected to receive over their lifecycle from the pension system. In Austria and Spain, however, there is a positive gap between the present value of pension benefits and social security contributions for generations born during the period 1900-1912 (Austria) and 1900-1940 (Spain). These generations have received a windfall gain from the public pension system. They did not have to pay contributions during all their working years, since the system did not exist, while by the time these cohorts retired, the system was in place and they received (and some of them are still receiving) pension benefits. The cohort born in 1900 (Austria) and in 1924 (Spain) experiences the highest gain, corresponding to 1.3% (Austria) and 1.4% (Spain) of lifetime labour income.

The fact that the present value of taxes paid is generally higher than that of benefits received is a standard result when considering transfers from young to old individuals, as is the case for the pension system. It is partly due to the effect of discounting.[5] To understand the intuition of this effect, consider a transfer system in which individuals pay a fixed amount of money for 20 periods during their working age and then they receive exactly the same amount of money during the following 20 years. When computing the present value at birth of taxes and benefits for this transfer system, we obtain a higher discounted value of tax payments than that of transfer receipts although the out-of-pocket monetary amount paid by individuals during their lifecycle is the same as the total amount received at the end of their lives. The reason is that tax payments occur earlier in life than transfer receipts, and are thus less discounted, in an upward transfer system.

[5] It is also because the economy is under dynamic efficiency.

Figure 2. Present value at birth of public pension benefits and taxes.



The fact that the gap between taxes and benefits is growing over birth cohorts results from the demographic evolution. In an ageing population, the decline in the support ratio implies that each generation of young individuals has to support an increasing number of elderly people. Hence, the net present value of pension benefits becomes lower and the rate of return in a pay-as-you-go pension system is reduced.

Figure 3 illustrates results for the public education system. Since education is a downward transfer, as opposed to pensions, in this case the picture changes completely, and the life cycle accounts are mostly positive and increasing for future cohorts. Cohorts born between 1907 and 1943 (Austria) and between 1927 and 1977 (Spain) pay more taxes for education than they receive, having a negative net present value at birth for this transfer programme. The highest loss amounts to 1.6% (Austria) and 4.4% (Spain) of lifetime earnings for those born in 1933 (Austria) and 1961 (Spain). The highest benefits in Austria and Spain are achieved for the cohort born in 2100, representing 30.0% and 34.4% of lifetime

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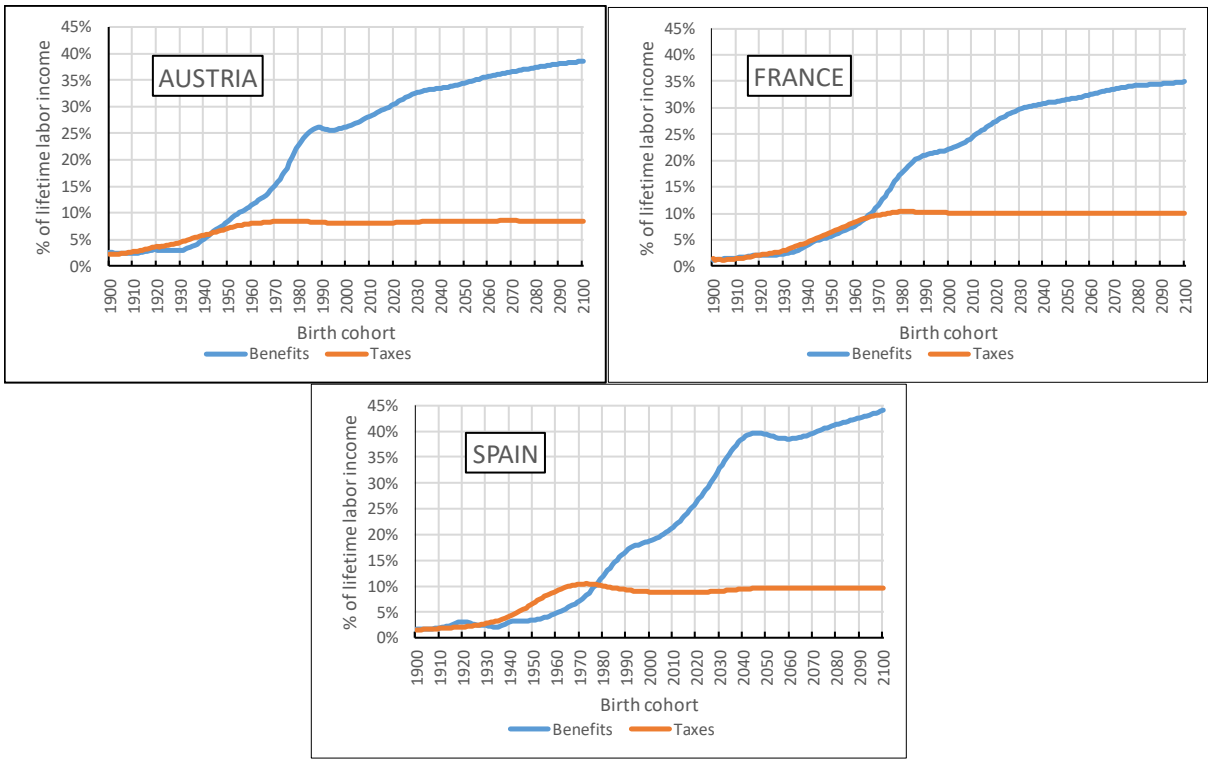
labour income. In France, cohorts born before 1968 are almost in lifecycle balance, with a net present value near zero. The highest gains from public education in this country amount to 25% of lifetime earnings for the cohort born in 2100. In all countries, cohorts born further in the future benefit more and more from the returns of higher education, which translate into higher wages in the labour market.

Figure 3. Present value at birth of public education benefits and taxes.



The lifetime-discounted survival-weighted benefits received from the health system and the corresponding taxes paid are displayed in Figure 4. Similar to pensions, for this public programme again the present value of taxes is above the present value of benefits for the majority of cohorts and countries. This is consistent with the health expenditure age profiles derived in NTA (see Figure 10 in Deliverable 5.5), which report higher values for the elderly. The exception are a few generations born at the beginning of the twentieth century in Austria and France, although the maximum positive gap is only 0.4% of lifetime labour

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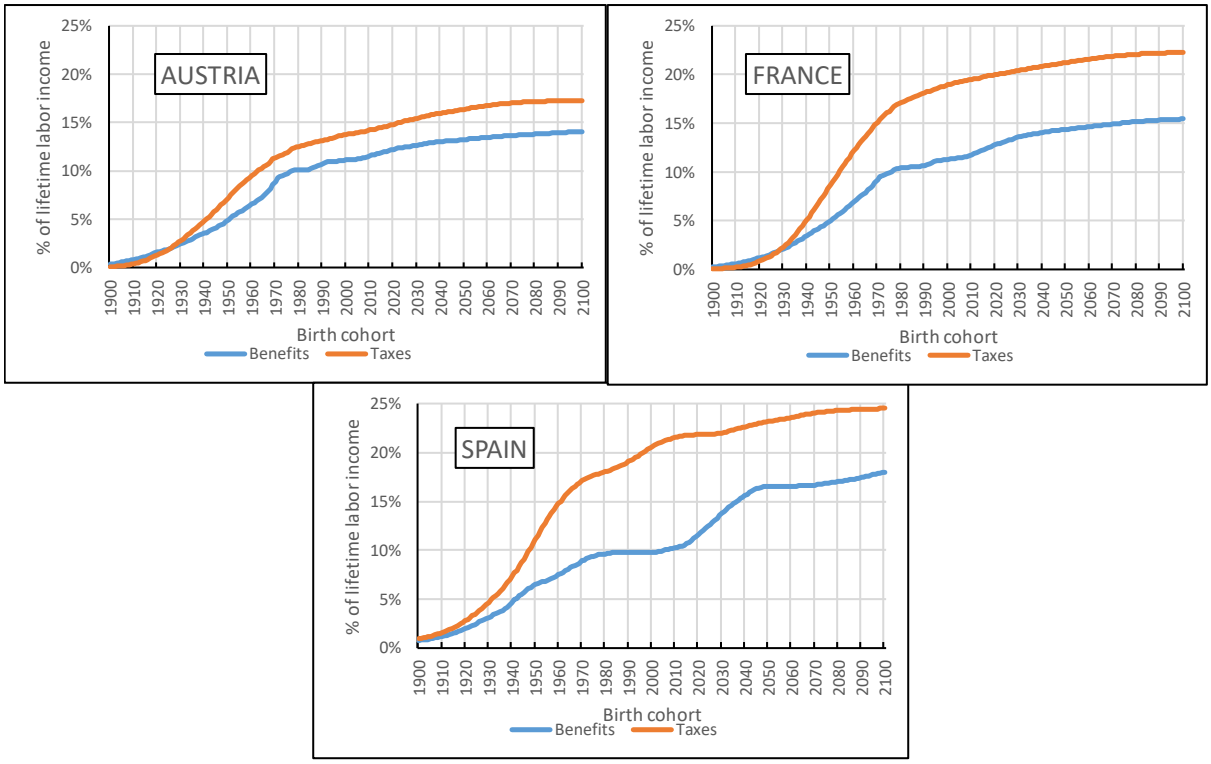
income. In all countries, the present value at birth of benefits and taxes increases at a higher pace until the 1970 birth cohort and more gradually later on.

Figure 4. Present value at birth of public health care benefits and taxes.



In the case of Spain, the evolution of both series is less smooth due to the effects of the ageing of the baby-boom generation and the lower fertility rate in the twenty-first century. This country reaches the highest present values of benefits (18.0%) and taxes (24.5%) and the largest gap between them, which corresponds to the generation born in 2009, who is projected to suffer a loss equivalent to 11.3% of lifetime labour income. Cohorts born between 1990 and 2020 in Spain suffer the highest losses as they are expected to pay larger tax bills to fund the health care of the Spanish baby-boomers.

In France, the present value at birth of health benefits rises up to 15.4% of lifetime earnings for the 2100 birth cohort, while the corresponding value for taxes reaches 22.2% of lifetime labour income. Generations born from 1980 in this country suffer similar windfall losses from the public health care system, amounting to around

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7% of lifetime earnings. Earlier generations experience lower gaps between health benefits and taxes. The maximum loss is for the 2007 birth cohort (7.8% of lifetime labour income). The less drastic demographic transition in France explains these results.

The Austrian public health system achieves the highest intergenerational fairness, as can be observed by the lower (and rather similar within cohorts) difference between the two series in Figure 4, ranging between 2% and 3.3% of lifetime labour income for all generations born from the 1950s. The present value at birth of taxes paid to fund public health in Austria reaches a maximum of 17.3% of lifetime earnings for the 2100 birth cohort, while the analogous figure for benefits is 14%. These lower values (as compared to the other two countries) are due to the lower scale of the Austrian age-specific health care profile.

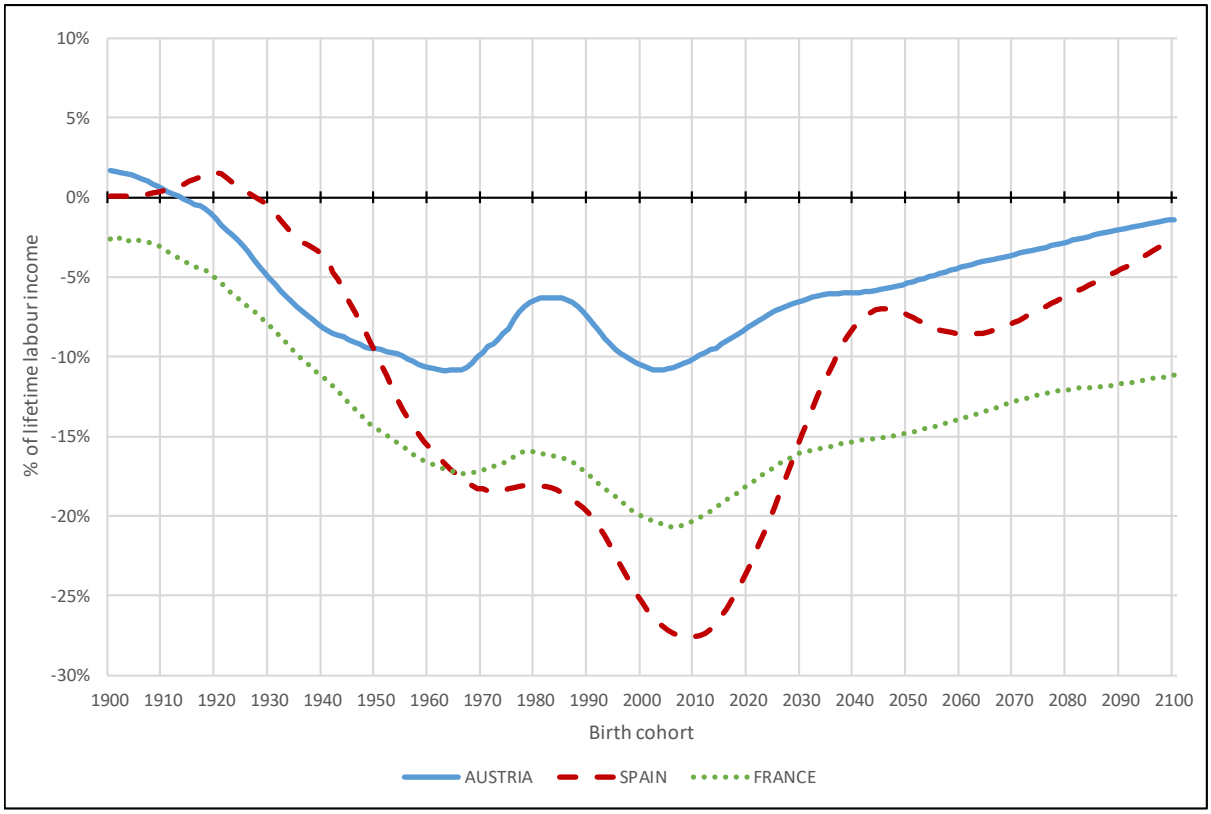
So far, we have analysed the net contributions of each generation in the three main pillars of the welfare state, that is, pensions, education and health care, relative to lifetime earnings. Next, we sum the lifecycle accounts obtained for each public programme and focus on the net impact of total public transfers.

Figure 5 shows the present value at birth of net benefits received from the public sector[6] for cohorts born in the period 1900-2100 in Austria, France and Spain. Generations born at the beginning of the twentieth century are the ones with the highest values in all countries. In general, these cohorts abstained from funding much of the expansion of the public education system and the health care system. The initial positive values for Austria are due to the modest net benefits obtained from the pensions and the health system. In the case of Spain, the initial cohorts mainly benefitted from the introduction of the social security programme, receiving a free lunch in terms of pension benefits with no (or relatively few) contributions to the system. Despite having to pay net taxes for the health system,

[6] We take into account pensions, education and health care. Hence, we exclude the "Other" category in public expenditure which includes expenditures on defence, justice and administration. Other social benefits are excluded from our analysis.

the combined net effect is positive. The positive values observed in Austria and Spain correspond to the birth cohorts until 1913 and 1927, respectively.

Figure 5. Net present value at birth of public transfers.



Cohorts born afterwards experience even lower net present values mainly due to the increasing cost of introducing and expanding the pension and health systems. The drop is larger in Spain because it is amplified by the rapid change in the population structure and by the expansion of the educational system (see Figure 3). The downward tendency continues in all countries until cohorts born in 1963 (Austria), 1967 (France) and 1972 (Spain), after which there is a period of 10-20 years where the net effect increases because of the benefits received from public education, which outweigh part of the losses attributable to pensions and health care. In the case of Spain, the expansion of the education system was delayed and such increase in the net effect is not appreciated. In all countries, subsequent birth cohorts have decreasing net present values especially as a result of the considerable rise in lifetime-discounted social security contributions and the

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modest drop in corresponding pension benefits. The peak loss is achieved for the 2003 birth cohort in Austria, amounting to 10.8% of lifetime labour earnings. The analogous figures for the other countries are a loss of 20.7% for the 2006 birth cohort in France and a loss of 27.6% for the 2009 birth cohort in Spain. From then on, the relative gains in education and health benefits lead the way in the three countries, most notably in Spain, and the net impact of public transfers becomes increasingly negative for each successive generation. The cohort born in 2100 suffers from net losses due to public transfers estimated to be 1.4%, 11.1% and 2.5% of lifetime labour income in Austria, France and Spain, respectively.

In accordance with the observed differences within countries in the present value of benefits and taxes of each public programme displayed in Figures 2 to 4, the shape of the total net effect by birth cohort follows a similar pattern in all of them. In Spain, nonetheless, the evolution is markedly more volatile by virtue of a more dramatic demographic transition. This suggests a higher intergenerational redistribution of income in this country induced by public policy. Another distinct feature of the evolution of the Spanish lifecycle accounts is that they occur with a certain delay with respect to the other two countries. This reflects the late introduction of the welfare state in Spain, just as the more gradual expansion of the public programmes. The positive effects of public education are particularly postponed, although they reach higher values once they are achieved. In France, there seems to be more intergenerational fairness as the fluctuations in net present values are milder. However, the French public programmes are the ones offering the lowest return for future generations, as can be appreciated in Figure 5. Spanish cohorts born between 2000 and 2017, achieving more than 25% of lifetime labour income, suffer the highest losses of all generations in all countries.

Overall, our results indicate that the positive effect of public education never offsets the negative effects of public pensions and health care for generations born after 1927 in the three countries we focus on. This contrasts with the results obtained in Bommier et al. (2010) for the US, who find that cohorts born between 1947 and 2060 attain positive net present values. The lower generosity of the American pension system plays an important role when trying to understand the

reasons behind these differences. Another relevant aspect when comparing our results with the ones of Bommier et al. (2010) is the inclusion of general equilibrium effects in our analysis. For example, the future interest rate used to discount benefits and taxes to obtain the present values at birth is not constant in our framework, but it results from the general equilibrium model and evolves according to the demand and supply of capital in each year. Higher interest rates give more weight to downward transfers such as education since they imply larger values for the benefits that occur earlier in life than for the taxes that are paid later. The opposite is true when considering a transfer system redistributing from young to old as the pension system. Therefore, a higher interest rate improves the net present value at birth for downward transfers and worsens it for upward transfers.[7]

4. Reform scenarios

As seen in the previous sections, our projections indicate that the welfare state system has substantial fiscal imbalance in the long run if it is to be maintained as we assume in the benchmark scenario. Hence, it requires remarkable tax adjustments in order to make it sustainable. This, in turn, deteriorates the fiscal balance within generations, enhancing intergenerational redistribution and worsening intergenerational fairness. In this section, we present different reform scenarios and assess their capacity to balance the sustainability and the intergenerational fairness of the public programmes of the welfare state.

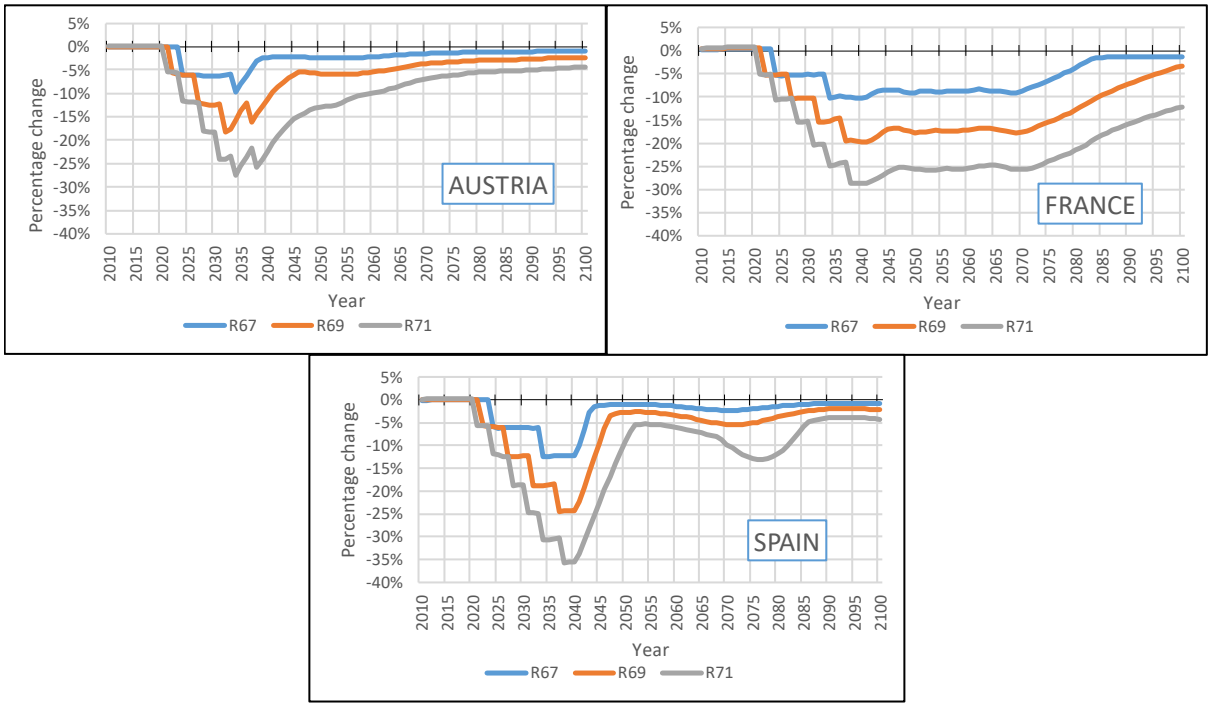
4.1. Delay in retirement age

There is a large literature on the reform of the pensions system. Besides decreasing pensions and increasing contributions –both reflected in our baseline scenario— most studies point out the postponement of the statutory retirement

[7] Another difference with respect to Bommier et al. (2010) is that we assume that health costs grow at the same rate as productivity, while they assume a faster growth rate for health expenditure.

age as an advisable policy. This policy proves to be very effective as it affects both the revenue side and the expenditure side of the system by increasing the period of paying contributions and decreasing the period of receiving pension benefits, especially if implemented when a relatively numerous generation of baby boomers retires. Moreover, it seems desirable under the ongoing demographic changes as long as life expectancy is increasing and taking into account the fact that longer education delays the entry into the labour market (see Lee 2016).

Figure 6. Change in Pension Expenditure / GDP of delaying the retirement age.



We have simulated the effects of delaying the retirement age from 65 to 67, 69 and 71 years old. The reform is implemented progressively during 20 years starting in 2020. Figure 6 reflects the variation in the expenditure to GDP ratio with respect to the baseline in the three counterfactual scenarios, i.e. when the retirement age is postponed until individuals are respectively 67, 69 and 71 years old. From 2020, the year in which the reform starts being implemented, public pension expenditure drops in the three countries as a share of GDP. Further reductions are observed in the following twenty years when the policy change is being carried out. After 2040, the difference with respect to the baseline shrinks

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progressively until it is minimized in the future, although still with a negative net effect. The pattern is somewhat distinct within countries, the changes being the lowest in Austria and the most gradually distributed across generations in France.

At the same time, the sequences are similar for the three chosen retirement ages within each country, with the later ages always having a stronger effect. When retirement is delayed two years, the ratio drops up to 10-12% in the most critical years; it does so until 18-24% if it is delayed four years; and up to 27-36% if the new retirement age is set at 71 years old. The largest effects occur in Spain, where the percentage change of pension expenditure over GDP experiences another distinguishable reduction in the 2070s when retirement is postponed until the age of 71. This has to do with the dissipation of the baby boom generation in that decade.

Another interesting result of delaying retirement is displayed in Figure 7, which plots the change in tax rates –including social security contributions— under different retirement ages with respect to the baseline, i.e. retirement at 65 years old. As expected, the most direct effect is on pension contributions, which fall as the age of retirement is postponed, declining to a higher degree as it moves towards older ages. The largest reduction amounts to 7-11% when retirement is set at 67 years old, 14-22% at 69 years old, and 22-32% at 71 years old. The lowest values belong to Austria and the highest to Spain.

The labour income tax is also reduced by these reforms since the working age period is extended and thus a lower tax rate on labour earnings is necessary to raise the same revenues. The other two taxes, on consumption and capital income, show a more ambiguous effect due to the shape in the specific age profiles of these tax receipts and to the projected size and demographic structure of the population in each future year. As a result, the changes in these three tax rates (on consumption, capital income and labour income) are much smaller than the ones for social security contributions, amounting to a maximum of 10% in the most extreme scenario where retirement is delayed six years. In the long run, all tax rates decline when these reforms are implemented.

Figure 7a. Change in tax rates under different retirement ages in Austria.

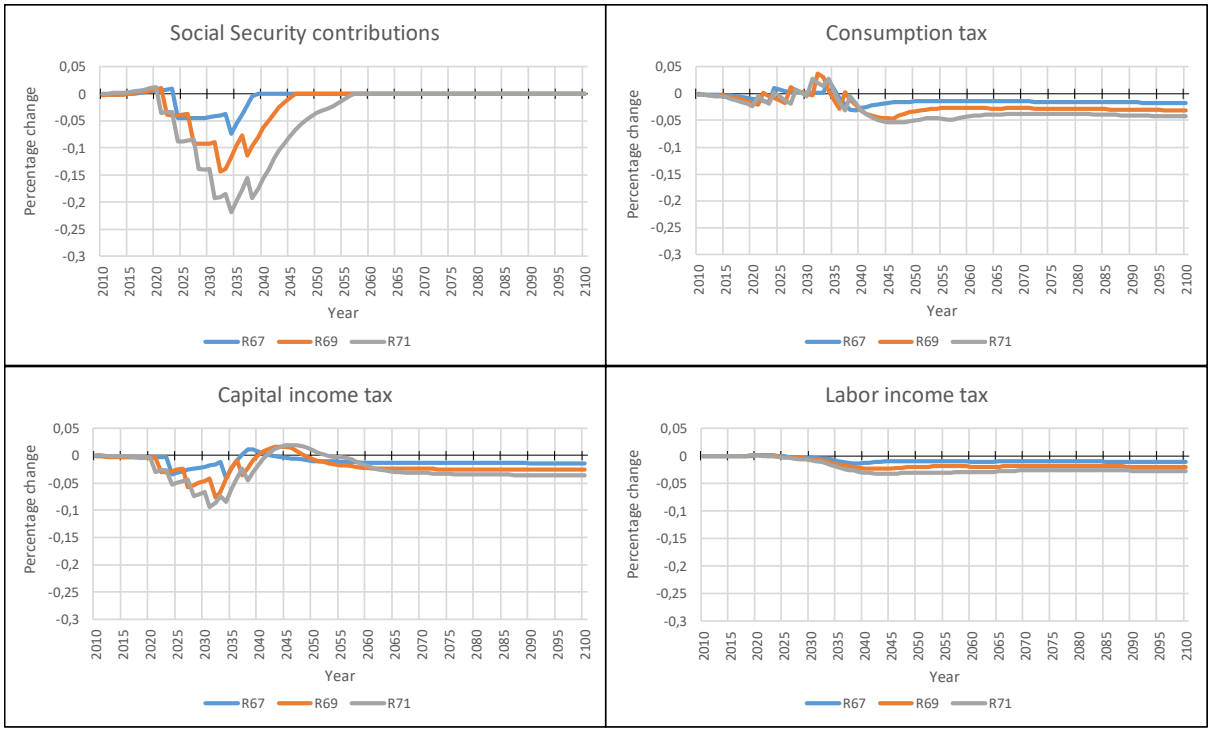

Figure 7b. Change in tax rates under different retirement ages in France.

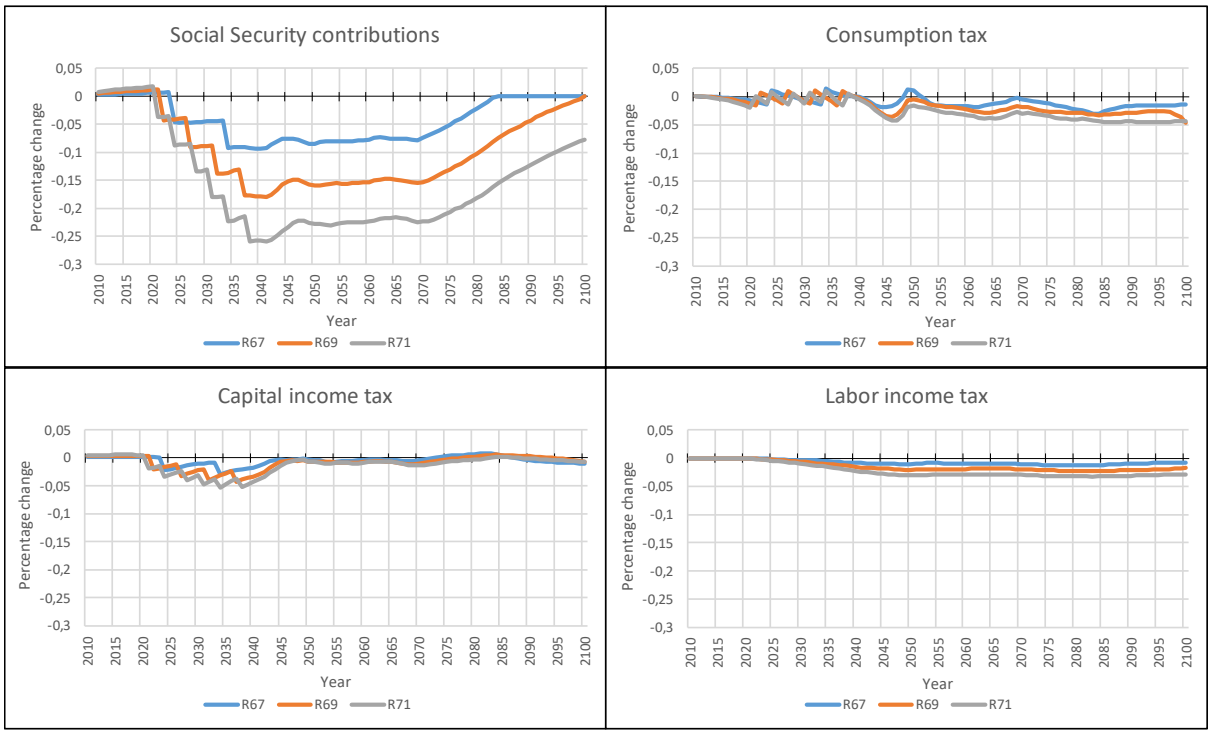

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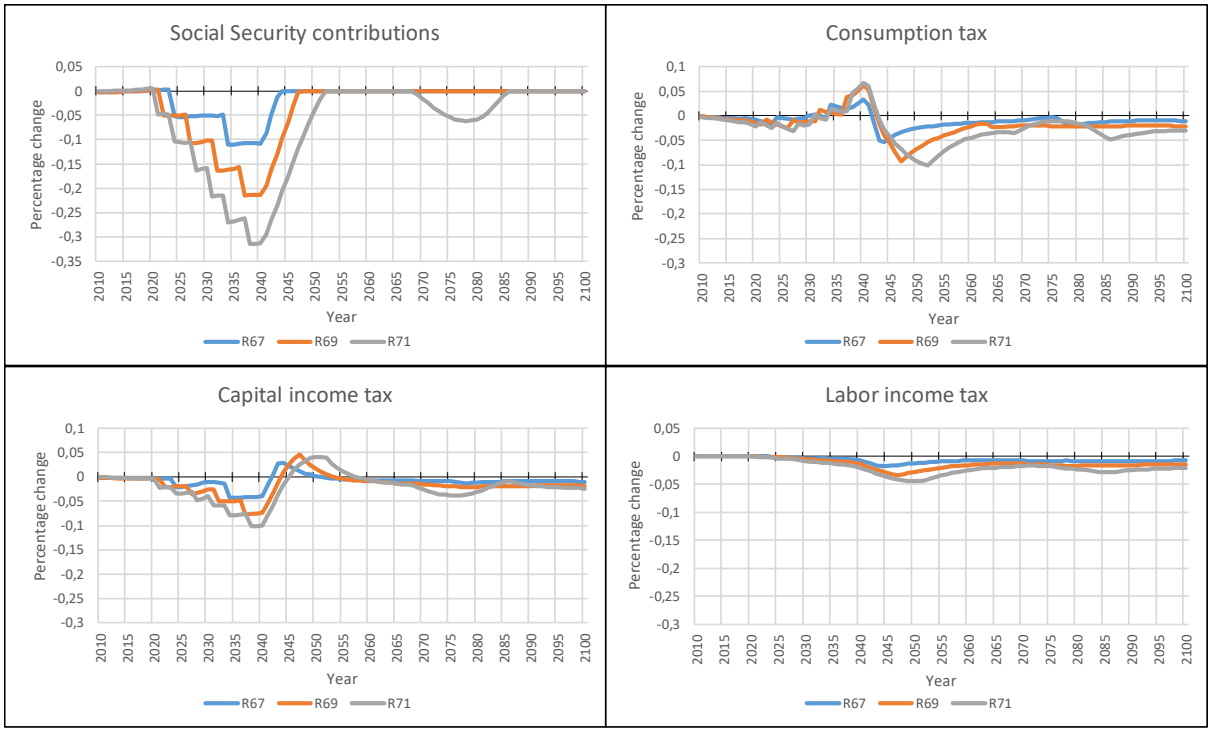
Figure 7c. Change in tax rates under different retirement ages in Spain.



The differences among countries again respond to the particular characteristics of each country's demographic transition. In fact, the shape of the change in social security contributions displayed in Figure 7 resembles that of the change in the pension expenditure to GDP ratio reported in Figure 6.

All these changes derived from the postponement of the retirement age translate into variations in the net present value of public programmes derived in the previous section. Figure 8 displays the change in total net present value of the combined pensions, education and health systems for cohorts born from 1950 to 2100 as compared to the baseline scenario. Although the main impact of a policy of delaying retirement is expected to be on the present value of taxes paid and benefits received from the pension system, several effects on pensions and contributions may offset each other minimizing the net result on this programme. On the one hand, delaying retirement implies that pension benefits are received during a lower number of periods and contributions are paid during a larger number of years. Both factors push down the net present value at birth of

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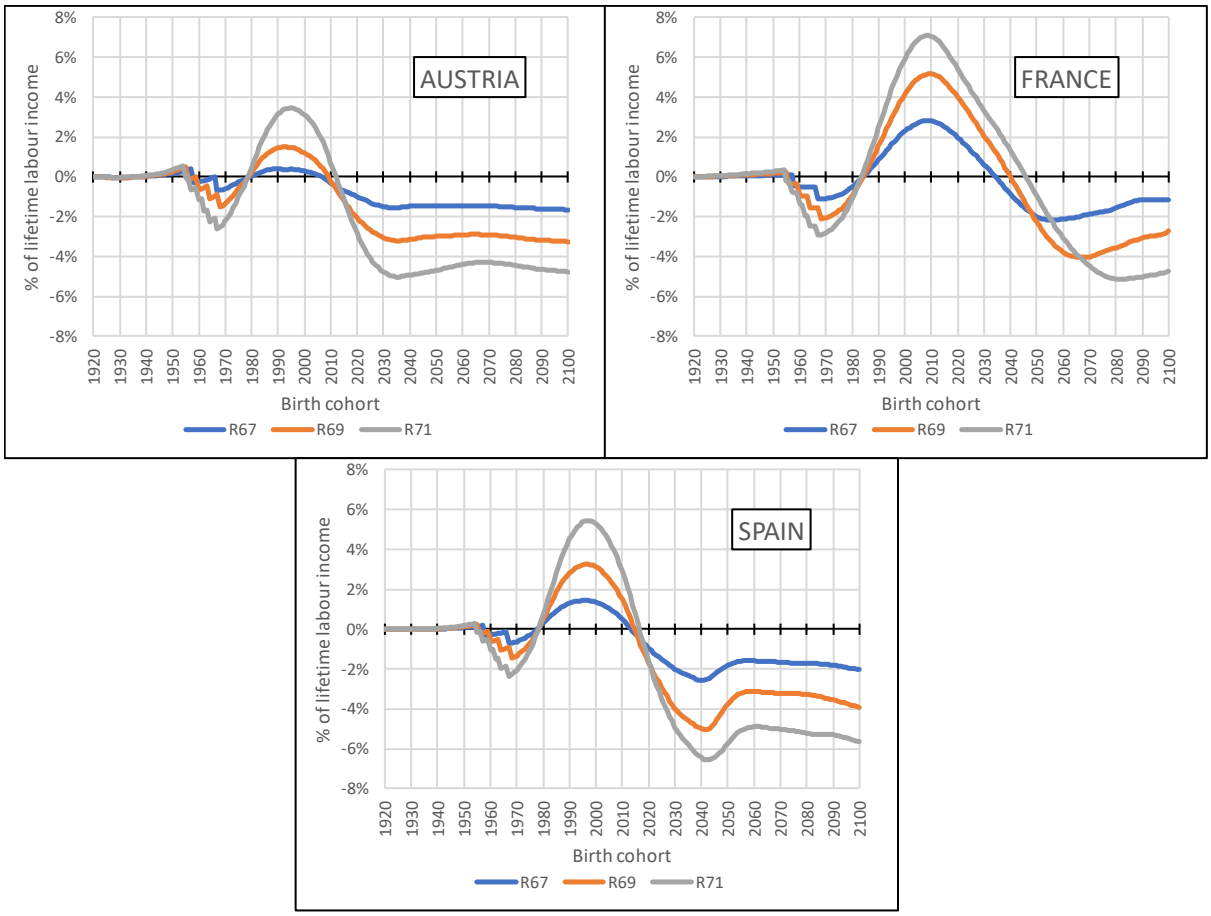
participating in the pension system. On the other hand, the general equilibrium nature of the model together with the assumption that the system is balanced every year on a PAYG basis entail a reduction of the contribution rates and a potential increase in benefits received. In this case, the consequence is to improve the net present value of public pensions.

The evolution of the variations in the various reform scenarios shown in Figure 8 reflects also the changes in the other public programmes (education and health care) due to general equilibrium effects. Overall, for any postponement of retirement, the old generations that are near the end of their working life at the time the policy is implemented –born approximately between 1950 and 1980— lose from the reform. Future generations –or those who are very young at the start-up of the reform in Austria and Spain— also lose from the delay in retirement, while young generations benefit, obtaining a higher net present value at birth as compared to the baseline. The size of these changes in benefits and losses positively depends on the number of years the age of retirement is postponed. In the most extreme scenario (retirement at 71), the maximum losses for the initially old generations are between 2 and 3% of lifetime labour income, being larger for future generations (around 5% in Austria and France, and around 7% in Spain). The highest gains amount to 3.5% of labor earnings in Austria for the 1995 birth cohort; 5.4% in Spain for the 1997 birth cohort; and 7.1% in France for the generation born in 2009.

Focusing on the differences between countries, not only the levels of maximum gains and losses with respect to the baseline are distinct, but also the time path when these changes occur. The generations that gain from the reform are those born from 1980 to 2006 in the 67-retirement scenario in Austria, extending this period to 1979-2009 and 1979-2011 in the 69 and 71-retirement scenarios respectively. The corresponding birth cohorts in France are the 1985-2034 (spreading to 5-6 more years for each additional longer reform of the retirement age), and in Spain the winners are born between 1978 and 2013 (1979-2014 and 1979-2016 respectively). Hence, the benefits of the reform are somewhat larger – as well as spread out across more generations— in France. Recall that the

maximum contribution rate for the social security system is set at 35%, and once it is reached the adjustment comes from reducing pension benefits. Because of a less drastic ageing process, this limit is achieved later in France (and is never reached in the 71 retirement age scenario in this country), which explains the previous results.

Figure 8. Change in net present value of public transfers under different retirement regimes.



4.2. Changing the tax base

While public expenditures are mostly directed to both sides of dependency (children and the elderly), taxes are mostly paid by the working population, although some of them are also supported by children and the elderly. This implies that it might be relevant to consider changing tax bases to meet the constraints

the government is facing as a result of the ageing process. As shown in Table 1, the tax bundle used to finance public health and education is different to some extent in each of the countries we consider in our study. Since this may be one of the factors that influence the results we obtain, we develop two alternative scenarios in order to understand to what extent the choice of a different tax mix alters the consequences of our analysis. To keep things simple, we focus on only one of the public programmes and implement a gradual reform by altering the funding source to one tax base instead of a mix of the three as we assume in the baseline.

In particular, the policy reform we analyse consists of changing the tax base to finance future health care spending from year 2020 onwards, and it is implemented progressively during a period of twenty years. We consider two policy options: financing future health expenditure using only taxes on consumption, and alternatively using only taxes on labour income. In either case, we assume that public health is funded from the receipts of only the chosen tax basis, which implies that that specific tax rate increases while the other two decrease. We opted for not using the capital income tax in these counterfactuals because of the high deadweight losses that this policy would imply.

Table 2. Changes in tax rates from financing health using different tax bases.

Tax financing health		Consumption tax			Labour income tax		
% change in	Year	AUSTRIA	FRANCE	SPAIN	AUSTRIA	FRANCE	SPAIN
Consumption tax rate	2050	60.7	51.2	60.5	-45.8	-41.6	-47.5
	2100	63.3	49.3	57.1	-48.7	-45.0	-45.7
Capital income tax rate	2050	-42.8	-38.7	-43.0	-43.7	-39.4	-42.5
	2100	-44.7	-40.6	-41.3	-47.5	-43.0	-42.8
Labour income tax rate	2050	-45.9	-43.0	-47.3	51.4	71.7	82.9
	2100	-49.0	-45.4	-46.4	55.8	77.7	83.8

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Table 2 reports the percentage changes in all tax rates (on consumption, capital income and labour income) with respect to the baseline of changing the tax basis for financing health care. Results are displayed at two points in time (years 2050 and 2100) after which the reform has been fully carried out and the strongest effects have been realized. If health is financed by taxing only consumption goods, the corresponding tax rate on consumption is projected to increase – as compared to the baseline scenario where a mix of the three tax bases is used— from 17.5% to 28.1% in 2050 in Austria, from 23.1% to 34.9% in France, and from 18.7% to 30.1% in Spain. The analogous figures in 2100 are rather similar (32.6% in Austria, 37.1% in France and 30.0% in Spain). Thus, the required adjustments are lower in France, which is the country with a larger initial level of this tax rate (and after the reform, this is still the case). Both the capital income and the labour income tax rates decline between 40-49% in the three countries in the decades following the full implementation of the reform.

If health care is financed by taxing only labour income, the necessary adjustments in this specific tax rate are larger –as compared to the first reform using consumption taxes—in France and Spain (an increase of 72% and 78% in France and of 83% and 84% in Spain in years 2050 and 2100 respectively). In Austria, which has a higher initial level of this tax rate, they are lower (51% in 2050 and 56% in 2100), but after the reform Austria is still the country with the largest labour income tax rate. In all countries, the other taxes decline between 39 and 49% along the twenty-first century.

The impact on the total net present value at birth of pensions, health and education is shown in Figure 9, reporting the change with respect to the baseline. For all countries, there are large gains for all generations if public health is financed exclusively through labour income. This is because a tax on labor income depletes more capital per worker than a tax on consumption. As a consequence, the interest rate increases, which gives more weight to transfers received early in life (education) than later in life (pensions and health care), thus increasing net benefits. In Austria, these benefits monotonically increase with birth cohorts, and the maximum gains amount to 11.7% of lifetime labour income for the generation

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born in 2100. In France, they increase until the 2048 birth cohort (with 13.5% of lifetime earnings higher net gains as compared to the baseline) and then they remain rather constant, achieving 13.8% for the last cohort born in 2100. The evolution is somewhat distinct in Spain, achieving a maximum difference of 14% for the generation born in 2011, then decreasing to 10.2% for the 2042 birth cohort, increasing modestly to 11.1% for the 2061 birth cohort, and finally decreasing again reaching a positive difference of 9.2% for the 2100 birth cohort.

Alternatively, if the tax basis used to finance public health care is consumption, generations born between 1976 and 2023 in Austria gain as compared to the baseline. Similarly, the 1972-2047 birth cohorts in France and the 1979-2030 birth cohorts in Spain benefit from this policy scenario. The largest gains are achieved by the generation born in 2002-2004 (depending on the country) and are highest in Spain (11% of lifetime earnings) and lowest in Austria (4.9%). In France, the maximum gains correspond to 8% of lifetime labour income. The other generations lose, especially the future ones. The losses for the 2100 birth cohort amount to 4.6%, 1.6% and 6.6% of lifetime earnings in Austria, France and Spain, respectively. The losses for the previous cohorts are much smaller, reaching less than 1% (in absolute terms) in all cases.

4.3. Fixed education

One of the most distinguishing features of the model we use to derive the previous results is the degree of heterogeneity with respect to the education level of the population. As discussed in Deliverable 7.1, there are important differences in the educational composition of workers across countries, which generate diverse behaviour leading to distinct economic developments. In order to assess the impact of education on our results, we develop a scenario in which the educational attainment as observed for the cohort born in 1980 is held constant for the future.

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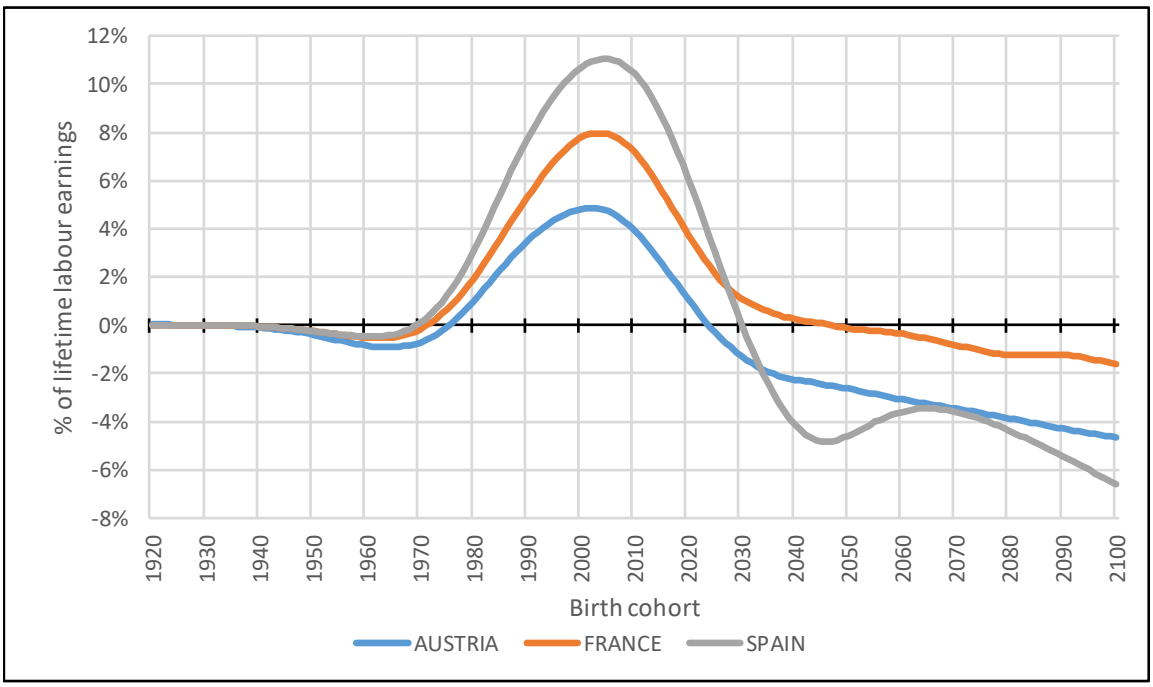
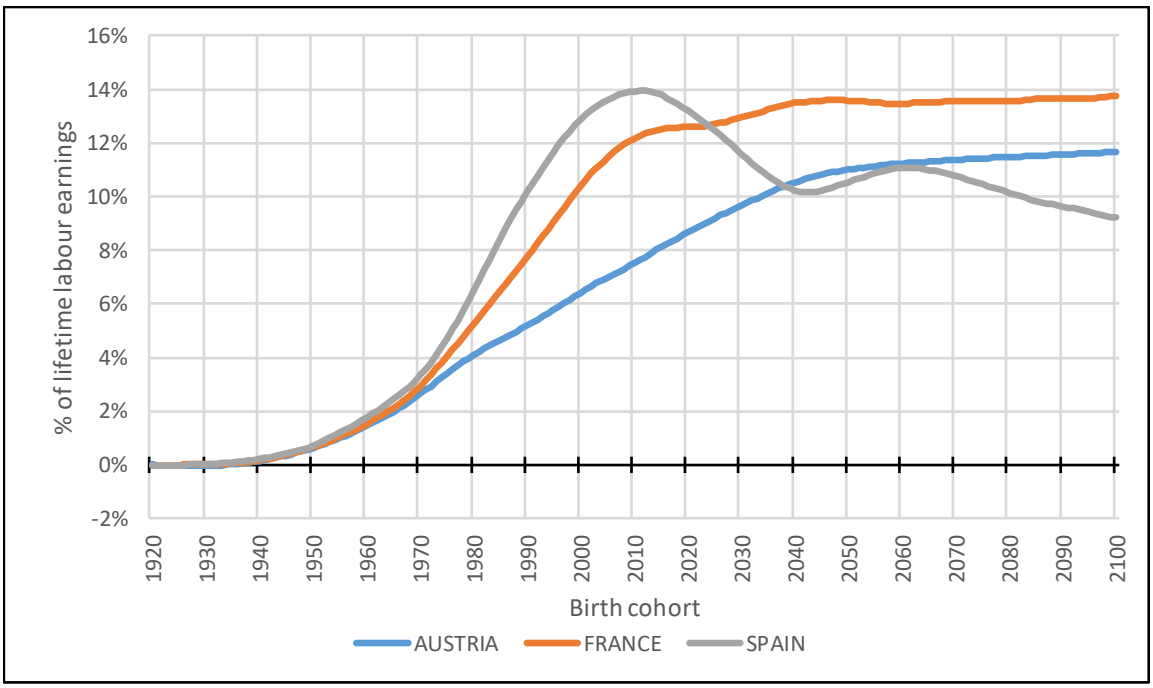
Figure 9. Difference in net PV of public transfers when changing tax bases.

(a) Financing health care with consumption taxes



(b) Financing health care with labour income taxes



Before looking at the impact of such experiment, let us focus on the details and significance of the proposed scenario. Table 3 reports information on the actual

and predicted educational composition for several birth cohorts in Austria, France and Spain. Three levels of education are considered, according to the UNESCO classification: ISCED 0-2 (lower secondary education or less), ISCED 3-4 (upper secondary education) and ISCED 5+ (tertiary education). The cohort born in 1980 is in the middle of the educational transition in all countries, although this transition is experienced at a different pace in each country. In France, 44% of individuals born in 1980 attained tertiary education. The analogous figures in Austria and Spain are 24% and 33%, respectively. The shares of population with ISCED 0-2 and ISCED 3-4 for the same birth cohort amount to 15% and 61% in Austria, 15% and 41% in France, and 28 and 39% in Spain. This reflects the fact that the change in educational composition was delayed in Spain, as discussed above. These differences among the three countries shrink by 2040 and by the end of the century, when all individuals are assumed to attain at least upper secondary education. For the 2100 birth cohort, the percentage of population with tertiary education is five points higher in France than in Austria, and two points higher in Austria than in Spain.

Table 3. Percentage of population by education level by birth cohort in Austria, France and Spain.

Country		AUSTRIA			FRANCE			SPAIN		
Education level (ISCED)		0-2	3-4	5+	0-2	3-4	5+	0-2	3-4	5+
Birth cohort	1980	15	61	24	15	41	44	28	39	33
	2040	1	30	70	0	23	77	1	31	68
	2100	0	22	78	0	17	83	0	24	76

Source: WIC Data Explorer (2015).

Figure 10 shows the impact of the fixed-education scenario on the net present value at birth of public programmes for cohorts born between 1920 and 2100 in Austria, France and Spain. In all countries, some cohorts obtain net fiscal gains from this scenario (those born in the period 1952-2007 in Austria, 1949-1995 in

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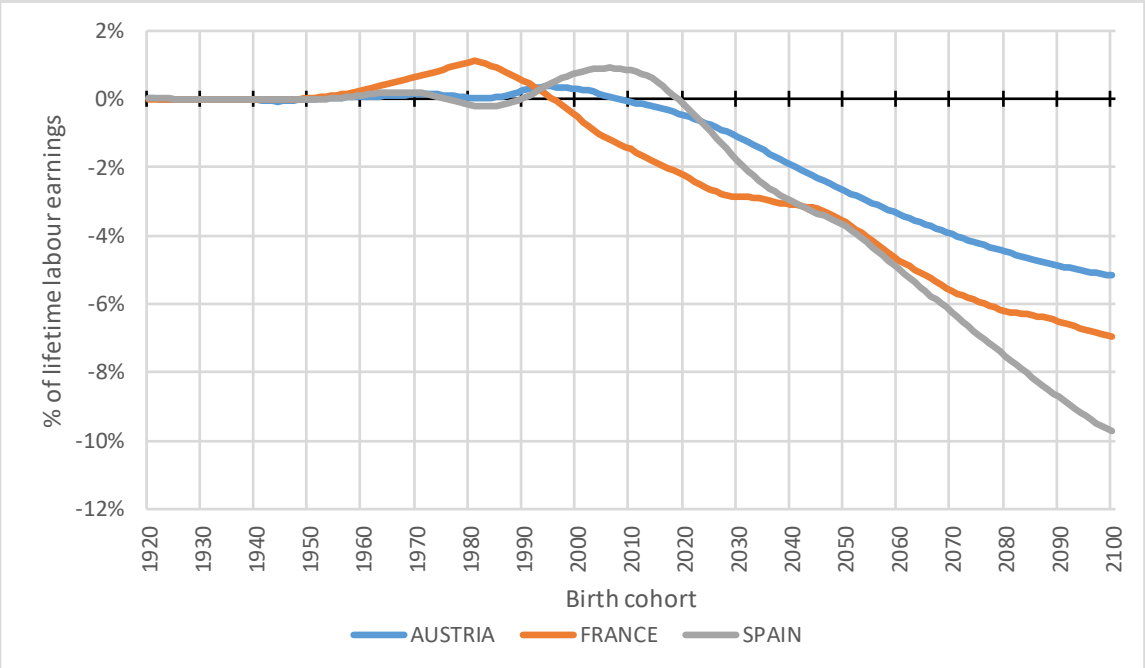
France, and between 1990 and 2018 in Spain[8]) but the positive effect is small. If educational attainment is fixed at the 1980 birth cohort levels, these generations have to pay lower taxes for the education of their descendants, and they also lose some benefits from their own education, which is lower on average. In this case, the former effect dominates. For previous generations, the variation with respect to the benchmark scenario is hardly appreciated. Future generations suffer the most important losses, which are higher in Spain and France. For the cohort born in 2050, they represent, in terms of present value of lifetime labour income, 2.7% in Austria, 3.6% in France and 3.7% in Spain. For the cohort born in 2100, these losses amount to 5.2% in Austria, 6.9% in France and 9.7% in Spain. They are due to the lower benefits from education received by these generations.

Figure 10. Difference in net PV of public transfers with fixed education.



[8] Generations born in the period 1954-1975 also obtain a positive change in the net present value in Spain, although it is very low (less than 0.2%).

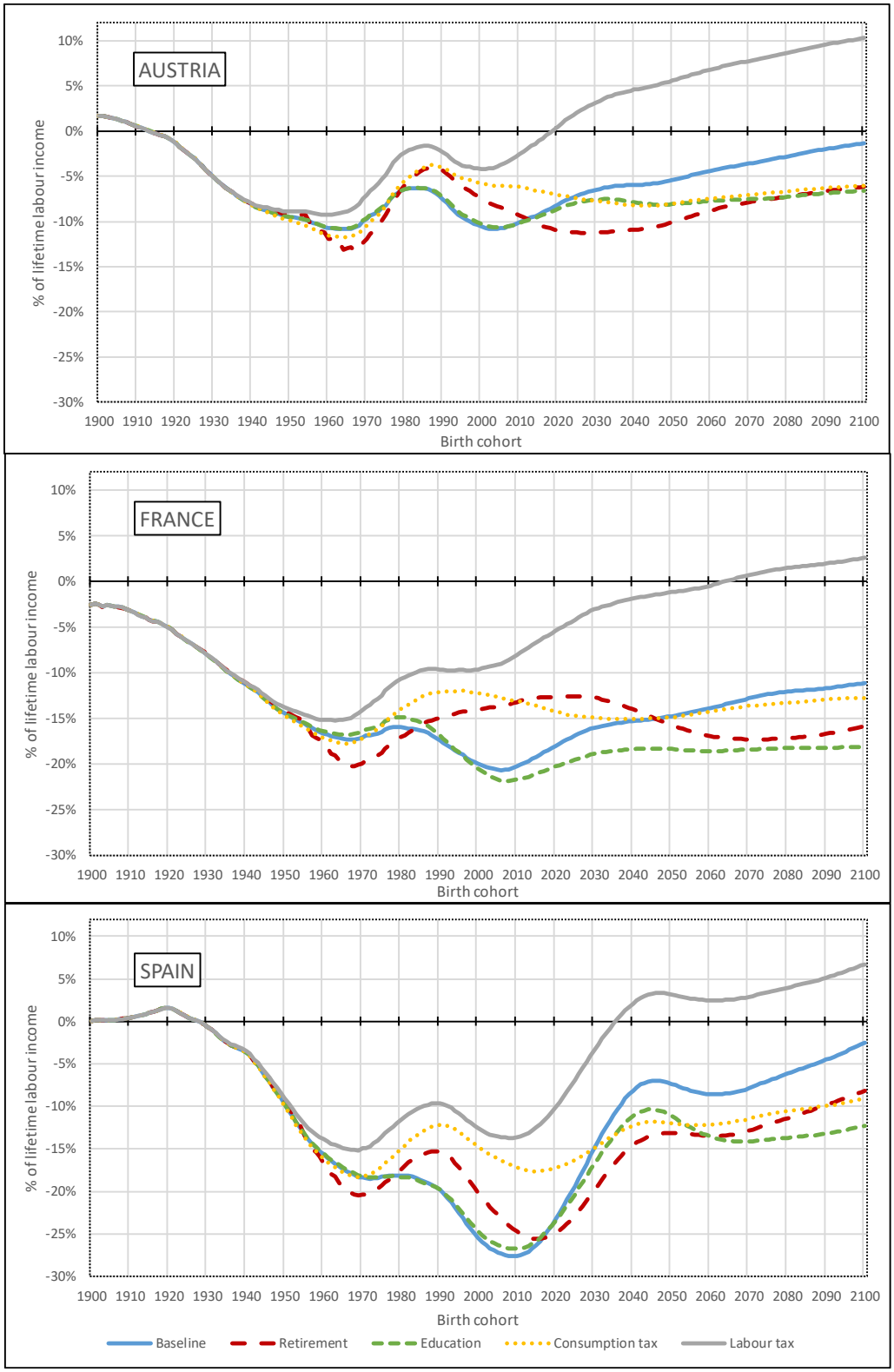
5. Conclusion

In this paper, we have analysed the impact of population ageing on the sustainability of public fiscal policy and we have explored the implications of several reform scenarios, including a delay in the statutory retirement age from the labour market and a change in the tax basis financing health care expenditure. We have also described the consequences of having a distinct educational attainment of the population in order to assess the effects of education on the results. We have focused the analysis on three European countries (Austria, France and Spain) which differ in their demographic transition and in the path of development and generosity of their welfare state programmes.

The results for sustainability show a drastic increase in the share of public expenditure to GDP on the three main programmes of the welfare state (pensions, education and health care). The total expenditure on these programmes goes from 26% (Austria), 25% (France) and 19% (Spain) in 2015 to 36-37% in 2050. This is mostly driven by the change in the ratio of benefit receivers to tax payers directly linked to the demographic dependency ratio. The necessary tax adjustments affect generations quite differently.

Figure 11 summarizes the main results, showing the net present value of public transfers (pensions, education and health care) for the distinct scenarios. We have included only one of the reform scenarios delaying the retirement age (namely, the most extreme one where retirement is postponed from 65 to 71 years old; see red line). The other two simulations (to 67 and 69 years old) yield milder effects in the same direction. We have also included the scenarios where health care is fully financed through consumption (yellow dotted line) and labour income taxes (solid grey line) in the future; and finally the fixed-education scenario (dashed green line).

Figure 11. Net present value of public transfers under different scenarios.



In the three countries considered, the best scenario in terms of improving the net present value at birth of public transfers is financing health care with labour income taxes. All generations gain from such policy reform. In the case of funding public health with consumption taxes, this is not clear because there are winners and losers from the reform, in terms of net present value at birth. In fact, in all other scenarios (different from the "labour tax"), the reform is good for some cohorts, but future generations always lose as compared to the baseline.

In terms of intergenerational fairness, our results suggest that Spain is the country with the highest intergenerational redistribution from public policy in the benchmark scenario, and Austria with the least. The reforms of changing the tax basis seem to improve the intergenerational fairness in France and even more in Spain, as they flatten the evolution of present values across cohorts.

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