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AGEING AND RETIREMENT

Ageing, Pensions and Dependency – Introduction

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This issue of *Economie et Statistique / Economics and Statistics* offers five articles focusing on topics surrounding retirement and pensions, and dependency. Three of these arose as a result of a symposium held in late 2021:[1] two articles dedicated to dependency and one to the impacts of providing information to future pensioners on their knowledge of their entitlements. The two other papers are respectively devoted to an assessment of the effects of the 2010 reform on health before retirement and to a presentation of the most recent projection exercise carried out by the *Conseil d'orientation des retraites* (Pension Advisory Board – COR) in 2022 (COR, 2022). This collection of papers adds to a long list of past special issues addressing the consequences of ageing. In 1990, the journal contributed – not without controversy – to the launch of the debate on pensions (Insee, 1990), one year before the publication of the White Paper of the *Commissariat général au plan* (General Commission for Planning – Commissariat général au plan, 1991). Three articles in an issue from 1996 (Insee, 1996) on the economics of social security were also dedicated to pensions and a fourth addressed the management of the risk of dependency. A special issue in 2007 (Insee, 2007) then focused on the first results of the SHARE panel on health, ageing and retirement in Europe, which is used once again in one of the articles of this issue. Another special issue from 2011 (Insee, 2011) covered the assessment of the effects of the pension reforms (mainly those of 2003 and 2010) that had taken place since the publication of the White Paper and the series of reports that followed. The questions surrounding pensions and dependency were also the subject of the majority of the articles included in a special issue in 2015 (Insee, 2015) dedicated to the microsimulation tools used for analysing social policies, not forgetting the numerous articles that appeared separately in various editions of *Varia*, a list that would be too long to mention here, but some of which will be referred to below.

1. *International Workshop on Pensions and Ageing, held on 7 and 8 October 2021, co-organised by the Directorate of Social Policy at the Caisse des Dépôts et Consignations, the Institut des politiques publiques (IPP) and the Social Economy, Protection and Society Research Program of the University of Paris 1-Panthéon-Sorbonne.*

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In view of recent events, it will come as no surprise that, of the articles in this edition, this preface includes more detailed coverage of the COR projections. These were at the centre of the debate on the timeliness of a new reform, being used both to demonstrate its urgency and to question its necessity, depending upon the way one chose to read them. Should this be seen as a further illustration of the adage that we can make figures say whatever we want? Or is it a case of clarifying exactly what each figure is saying?

Frédérique Nortier-Ribordy's article addresses these questions. It examines two categories of difficulties encountered by the pension projection exercises. One applies to all types of projection: choosing the underlying assumptions. In the case of pensions, these mainly relate to demographics and economic growth. The other category relates to the choice of indicators to project. Which indicators are more relevant for characterising the financial viability of the pension system? Can we simply consider the ratio of pension spending to GDP? If we choose to think in terms of deficit, how can we calculate this, given the heterogeneity of the funding channels in the different schemes that make up the pension system? Any choice of indicator has its share of conventions, but are some more valid than others?

Projecting a Pension Balance: Demographic Assumptions and Sensitivity to Growth

Firstly, the question of assumptions. Currently, the demographic assumptions are not the factor of instability put forward most often as, for the next 15 years, a large part of the ageing process will continue to be driven by a major factor inscribed in the current age pyramid: the retirement of the baby boom generations. This movement started in the mid-2000s when the generation born in 1946 reached the retirement age, which was 60 at the time. From that 1946 generation onwards, the number of births remained at a high level until the mid-1970s: as a result, until around 2035-2040, that is 60 to 65 years after this, the number of people reaching retirement age will remain significantly higher than the number of deaths of older pensioners. Beyond this date, things are less clear, and there will no doubt be a need to progressively accept demographic uncertainty and find sustainable ways to adjust to this. However, at this stage, the biggest factor in the instability of the projections is, instead, the assumptions of economic growth.

So, why this sensitivity to economic assumptions? It is not inevitable. A system in which entitlements are tied to changes in wages would see its financial balance projections far less affected by economic growth assumptions: quicker growth would immediately translate into equivalent pension growth – and *vice versa* in the case of slower growth, or even decline. The change in the ratio between pension spending and GDP or the wage bill would be the same in all cases, both in the short and long term.

While this is not the case in the current system, this is because we have chosen to manage a significant proportion of the ageing shock by means of a shift towards price indexation. When entitlements are price-indexed, the benefits that pensions receive from growth accelerations are delayed and are only partial. The pensions/wages ratio converges towards a lower level as growth speeds up, to the point that it can even reduce the share of pensions in GDP. However, if growth slows significantly and lastingly, pensions fall only slightly, not enough to counterbalance the part of the demographic shock not managed by increasing the retirement age.

Should we deduce from this that we should return to full wage indexation? The problem is that there would be a need to find other ways to solve the budgetary equation as we would have a spending trajectory independent of growth, but much more dynamic than any of those that the COR is currently projecting. The problem is therefore not simple. While awaiting a potential solution, for as long as we use price indexation, the results of the projections will continue to be affected by a structural instability and the question surrounding the plausibility of growth assumptions will remain. This is a subject about which the COR has long been accused of being excessively optimistic. In 2022, it

responded to this by significantly downgrading its assumptions, with a new assumption of just 0.7% per year for long run productivity gains, after having long used 1% as the lowest assumption. The highest assumption has been changed as well, from 1.8% to 1.6%. Is this high assumption still too high? Is the low assumption low enough? It is difficult to answer these questions, but there is a need for reflection here as questions are mounting as to both the feasibility and appropriateness of sustained growth, and even as to the very nature of what the term 'growth' covers.

What Type of Indicator Should Be Prioritised: Ratio Between Pensions and GDP or Balance Indicator?

That being so, this uncertainty factor is also compounded by the other question of choosing what indicator(s) to project, as the message given by the projections depends not only on the economic growth assumptions, but also on the angle from which we choose to examine the results.

For all these points, we can, in retrospect, say that things were clearer at the very start of the pension debate. In the introduction, we recalled the first time the journal addressed the subject back in 1990. The timeline explored then ran to 2040. In that initial situation, before any reforms had taken place, what was projected for that timeline was an increase of around 15 points in the total contribution rate, in a heavily stylised representation of the pension system at the time (Vernière, 1990). As a proportion of GDP, that would have represented an increase of around 7 points. At the time, the question surrounding sensitivity to economic assumptions and that of a deficit indicator had barely arisen. The principle of price indexation rather than wage indexation had not yet been written into law and the impact of productivity assumptions was not therefore even a topic of discussion. And, with such growth prospects, there was no need to explicitly quantify the deficit to conclude on the need for rebalancing. The change in the share of pensions in GDP was sufficient to show that changes were necessary, whatever anyone may have thought to be the optimal balance between the various levers of adjustment: increase in contributions, raising of the retirement age or reduction in the relative pension level.

This situation would only have persisted if there had been no reform. With the reforms seeking to re-balance the system, partly by using the price indexation tool, the trajectories of the spending-to-GDP ratios levelled out, on average, at the same time as revealing their sensitivity to growth assumptions (Marino, 2014). As a result, there was a shift from a single, clearly upward, trajectory to a range of more or less horizontal trajectories, with some showing slight growth, and others plainly showing decline. This is why it is difficult to say whether the reforms introduced were sufficient or not, making the work of the COR more complicated. The task entrusted to the COR was to reach a shared diagnosis on the outlook of the system; it was easier to reach such a diagnosis before the first reforms had yielded their full effects. However, as the reforms gradually ramped up, the pensions/GDP ratio began to offer a more ambiguous message, once again opening up a broad space for differences in assessments of the state of the system.

Was there a greater opportunity for convergence by using balance indicators rather than the pensions/GDP ratio? Balance indicators are no more protected from the effects of growth uncertainty; however they are calculated, they show the same range of trajectories. But, we expect, at the least, more clear-cut messages with given economic assumptions. A spending trajectory that is close to horizontal does not send a very clear signal on the need for rebalancing. A balance indicator does this more clearly as it sends a binary message. Either the future balances are excesses, which means the reforms made were more than sufficient, or they are negative and further adjustments are needed.

This is what led the 2014 reform to emphasise these balance indicators, as part of the new two-stage monitoring system it had chosen to implement: balance projections and projections for a certain number of other indicators established annually by the COR and, on that basis, an opinion from the new *Comité de suivi des retraites* (Pension

monitoring committee – CSR) deciding on whether or not the balance projection called for new measures.

This system worked, but brought to light the difficulties of this notion of balance. The balance has two components: spending and revenue. For a long time, it was thought that the most difficult component was the spending projection, given the complexity in the rules for calculating entitlements, with highly variable effects from one individual to another. It was for the purposes of managing this component that dynamic micro-simulation models projecting individual entitlements were developed, in order to better assess the total amount. And it is mainly here, at the level of this spending and its ratio to the GDP, that we see the sensitivity to economic growth assumptions. In comparison, it was possible to consider revenue projection much more directly: when a pension system is funded by contributions at a predetermined rate applied uniformly to an equally well-defined base, it is sufficient to carry out a macro-economic projection of that base, typically the wage bill. If it grows like GDP, revenue will grow to the same extent and the ratio between revenue and GDP will be more or less constant. This revenue then simply needs to be compared to the spending/GDP ratio.

However, projecting this "revenue" component of the balance calculation is not as simple as this, as we have never had this ideal type of system funded solely by contributions; rather we tend to move further and further away from it. We have never been in this ideal type because, for civil servants and numerous special schemes, the resources are not predetermined by a regulatory contribution rate: balancing is achieved automatically through payment of a balancing subsidy. In the case of the State Civil Service, a form of employer contribution can of course be seen, but this contribution gives no signal of imbalance due to the fact that its rate is automatically adjusted based on spending. And, for other schemes, even if the majority of funds come from contributions, this is almost always insufficient to achieve a balance and is supplemented by significant additional funding, either in the form of allocated taxes and duties, or from transfers from other schemes.

In this case, how can we aggregate projections that, on the one hand, relate to schemes for which there is no deficit indicator and for which imbalances must be considered in other terms, with those that, on the other hand, relate to schemes for which we know how to calculate the deficits, but which have resources with a funding structure that is not purely contribution-based?

Balance Indicators: Spoilt for Choice?

Historically, the COR chose to manage this problem by proposing two conventions. The first was a convention known as the "CCSS", as it was also used by the *commission des comptes de la Sécurité sociale* (social security accounts committee). It consists of aggregating, unaltered, the deficits of the schemes to which the notion of deficit applies, by projecting their income from contributions and the other transfers that they receive, and assuming that all other schemes renew their use of balancing subsidies, which places them outside the scope of the calculation. This convention offers a partial diagnosis, but has the advantage of a certain level of purity. The other convention consisted in treating the balancing subsidiary of the State (as the employer) as a form of contribution on its part, with an apparent rate obtained by reducing it to the level of its wage bill, then considering that rate to be constant in the projection rather than varying it based on spending, to give a measure of its latent imbalances. The result of this calculation has long been called the "COR convention".

The limitations of this second convention first emerged in 2017. Adopting restrictive assumptions about civil service employment and wages caused the projections of resources for that component of the pension system to plummet, giving the impression that the system was in a much worse situation than had been projected in previous exercises. This was, of course, highly paradoxical given that the employment and wage

scenarios for the public sector were chosen with a view to controlling the public deficits. Fiscal virtue had the collateral effect of tarnishing the outlook for the pension system when considered in isolation. However, the convention would not have been any less problematic if we had considered a symmetric scenario of significant increases in public wages and/or employment. This would have led to the message of an improvement in the overall financial situation of the pension system when, actually, with all other resources remaining constant, this policy would have had a negative impact on the overall balance of public finances. Despite the existence of very different opinions on the appropriateness of one civil service wage and employment policy or another, we cannot consider that simply increasing the public sector wage bill is sufficient to balance pensions, while entirely ignoring the question of how such an increase would be funded.

What this episode has ultimately revealed is that, once a significant proportion of pension funding is directly borne by the State budget, it becomes less relevant to consider the balance of the pension system independently of the overall balance of public finances. Considering these separately is only meaningful where the pension system uses only its own resources. As soon as balancing subsidies and allocated taxes and duties make the system dependent on overall budgetary resources, we can no longer think in these terms. At a push, if pension funding was fully tax-financed and was merely one of many State budget items, the only deficit issue would be the overall State deficit, and, as soon as that deficit would appear to be unsustainable, the question asked of the pension system would be of the extent to which it could contribute to the return to overall sustainability. To achieve this, we would directly ask if the share of pension spending in GDP is too high or not and whether there is a margin for reducing or limiting growth in that spending, by means of an examination that would put that spending on an equal footing with other public spending.

However, we are also not at such a level of State funding, and there is still demand for deficit indicators specific to the pension system. In 2018, to address the problem created by its indicator extending the apparent contribution rate of the State as employer, the COR chose to introduce a third convention, known at the time as the "GDP" convention, as it fixed the total State contribution to the pension system as a percentage of GDP rather than a percentage of its wage bill. Mechanically, this convention gave a balance trajectory that corresponded more or less to the spending trajectory reduced by a roughly constant percentage of GDP, on the assumption that the share of other financing bases in GDP (in particular the private sector wage bill) remained roughly constant. This convention was then renamed the "EEC" convention (*effort de l'État constant*, constant State support), while, at the same time, the CCSS convention was renamed "EPR" (*équilibre permanent des régimes subventionnés*, permanent balancing of subsidised schemes), and the former COR convention, which has since been abandoned, was renamed "TCC" (*taux de cotisation constant*, constant contribution rate).

If this "GDP" or "EEC" convention gives a more favourable result, it is because the projections assume, in time, a fall in the ratio between the public sector pension bill and GDP, and thus the same level of potential savings in the current balancing subsidies. Therefore, with State support set as a proportion of GDP, there is a surplus that can be implicitly assumed to be convertible into a new category of subsidies for the benefit of schemes with new deficits, primarily the general pension scheme. However, this assumes that the State does not envisage other uses for those surpluses. Clearly, we do not find ourselves in such a situation. At a push, we can even theorise that current balancing subsidies are already a sort of anomaly that hides the real overall pension deficit (Bouverin, 2022; Haut-commissariat au plan, 2022), assuming, however, that there is agreement on what a "normal" level of funding for the civil service pensions or subsidised schemes would be. We cannot consider the "normal" level to be the prevailing contribution rate in the private sector, if only due to differences in demographic structure.

All in all, what emerges from this is that there can be as many possible deficit indicators as opinions on what the State commitment in terms of pension funding, and more broadly,

the proportion of GDP that the community is willing to dedicate to this budget item, should already be or could be in future. Either we consider that we can maintain the current support by focusing it more towards schemes where the deficits are set to deepen, or we consider that this is already abnormally high and should be reduced as quickly as possible, or, finally, we consider that we should just let it fall gradually as spending for subsidised schemes falls, by allocating fiscal resources freed up in this way to other economic and social requirements. We cannot choose from among these different options without taking into consideration the importance and degree of urgency of those other requirements, and without bearing in mind the aim of achieving overall sustainability of public finances, by moving away from a silo approach that considers only pensions.

Projecting and Addressing Dependency

This observation acts as a bridge back to the first two articles of this special issue. Among the other items of public spending calling for renewed support, we of course think of the climate transition, which is also linked to the debate surrounding the COR's growth assumptions, the question being to determine a growth rate compatible with compliance with climate commitments. However, more closely associated with the subject of pensions is the question of funding dependency. In the area of dependency, the projections are far less systematic and institutionalised than in the case of pensions, although they could, from the outset, have been a systematic joint product of pension projections that would have received a similar attention. There are three explanations for this.

Firstly, when considered in the early 1990s, the problem appeared very distant, as this is a phenomenon focused on ages well beyond retirement, as it concerns those aged 80 and above rather than those in their 60s. At the time, this equivalent of the first generations of baby boomers reaching retirement age around 2005-2006 was still 20 years off (i.e., around 2025), which could have given the impression that there was plenty of time. However, that time has passed and we are now addressing this turning point. The subject is therefore more pressing, hence its inclusion in this special issue.

A second reason is the financial weighting, as this is a budget item that, although growing, is much smaller than pensions, which has often given the impression that, unlike pensions, it would be able to be managed with minimal fuss. But this was, evidently, not a reason not to take an interest, given the challenge that the subject represents in terms of living conditions of both dependent people and their carers. Furthermore, even from a financial perspective, subjects that can all be considered negligible when taken in isolation end up being much more than negligible when aggregated.

A final reason is that, in the case of dependency, we were also able to rely on a natural dampener of the demographic ageing effect, the possibility that the age at which a person becomes dependent naturally shifts upwards as total life expectancy rises. This was the morbidity compression hypothesis: if the age at which a person becomes dependent shifts in the same way as life expectancy, or even more quickly, the prevalence of the phenomenon in the total population may remain stable or even drop.

However, the problem is that there is no certainty in such an outlook. Another possibility is that the age at which a person becomes dependent could rise more slowly than life expectancy, pushing the overall prevalence upwards. This introduces an uncertainty factor into the dependency projections, which was not (or was barely) present in the case of pensions. In the case of retirement, the average age of transition to pensioner status appears to be reasonably predictable due to known rules governing entitlement to benefits. The same cannot be said of the age at which a person becomes dependent, which is a much more random phenomenon than retirement and which is also gradual, with there being various levels of dependency and even the possibility, in some cases, of reversal.

To manage all this, we must find ways of parametrising the range of conceivable scenarios in order to characterise the possible future contexts. This is the subject of the article

written by **Mahdi Ben Jelloul, Antoine Bozio, Elsa Perdrix, Audrey Rain and Léa Toulemon**, the aim of which is primarily methodological. It introduces into a micro-simulation model flexible parameters for the likelihood of transitioning from autonomy to three successive levels of dependency, and flexible parameters for distributing the change in general mortality among autonomous individuals and those with different levels of dependency. For the latter, the authors take a central scenario in which the fall in mortality benefits the various population categories to the same extent, and consider the two polar marginal cases where this would benefit only individuals in good health or only dependent individuals, the latter scenario obviously leading to a mechanical extension of the time spent in dependence. The reference assumption for the transition probabilities between autonomy and successive states of dependency is that they retain the same structure. But this is only a rather pessimistic starting point as it leads to the stability of prevalences at a given age. It is supplemented by two variants, with a more or less marked increase in the probability of remaining autonomous, which enables us to better conform to the changes seen in recent years.

This type of modelling is of course meant to be used to help project requirements, in terms of both financing and establishments to house and care for dependent people. To achieve this, we need to know the usage behaviours of establishments providing care for elderly people. **Amélie Carrère, Emmanuelle Cambois and Roméo Fontaine** explore the determining factors of this usage. Age, gender and level of dependency are the baseline determining factors, for which the kind of models proposed by Ben Jelloul *et al.* can provide projections and have, indeed, already been used in existing projection exercises (Miron de L'Espinay & Roy, 2020). But this usage also depends on other socio-economic characteristics and the family environment of the dependent person. The joint effect of all these determining factors is explored using the *Handicap-Santé* [Health and Disability] and CARE (*Capacités, Aides et REssources des seniors* [Abilities, help and wealth of the elderly]) surveys. Between 2008 and 2015, the joint effect of these different factors provides a good account of the overall change in the rate of usage, without revealing any notable change in behaviour for given characteristics. This stability of behaviours suggests that, at this stage, there has not yet been a significant shift toward staying at home. If this were to remain true in the future, it would justify projections with constant behaviours, but based on projections also determining factors other than sex, age and level of dependency, in order to integrate them into a complete modelling of residential choices. However, it may also be the case that the behaviours stop being stable at given values for all these determining factors: we should, in particular, consider the sustainability of the role of relatives.

Retirement at Individual Level: How Do People React to the Rise in the Age of Entitlement to Pension Benefits? What Do they Expect of these Entitlements?

For our conclusion, we will now return to pensions. Of the arguments put forward in favour of increasing the retirement age is that of the overall increase in life expectancy. As this continues to rise from one generation to the next, there is scope for increases in the age of retirement which do not reduce the length of retirement, either in absolute terms or in proportion to an adult lifetime. Aubert & Rabaté (2014) explored what happened in this sense following the 2003 and 2010 reforms, and these indicators of absolute and relative lengths of retirement are part of the monitoring indicators planned for in the 2014 reform, updated annually by the COR and examined by the CSR. In the latest assessments to be conducted before the reform, but after incorporation of less favourable life expectancy scenarios, the average length of retirement is already projected to be just stable for the next 15 to 20 generations of people receiving their pension entitlements: it should remain comparable to that of the generation of 1940, although down by one to two years compared with that of the generations who retired just before the 2010 reform. What is now at issue is a possible further reduction of this retirement length. This may be the price to pay for keeping pensions at a sufficient level, but requires us to pay greater attention to inequalities in this retirement length within generations. This has been a

key focus point in debates on raising the minimum age, which, without compensatory measures or derogations, penalises population categories who have a shorter life span more severely.

Then, beyond overall life expectancy, there is also the question of life expectancy with good health, which the article by Ben Jelloul *et al.* dealt with, and which could be a better criterion for assessing the extent to which a retirement age rise is acceptable. Here again, the question is not one of intergenerational changes but of intragenerational disparities. And to this need of documenting levels of and changes in life expectancy with good health before any new reform can be added the one of documenting the effects that such a reform can have, in turn, on health: is there a risk that it could worsen health at a given age?

On this point, the article from **Eve Caroli, Catherine Pollak and Muriel Roger** recalls that the lessons learned from the literature are ambiguous (Garrouste & Perdrix, 2021). However, this literature focuses generally on the effects of the retirement age on health after retirement. Their article examines more the question of the impact of such a shift on health before retirement, by using the discontinuities in retirement age generated by the 2010 reform. How has the health of individuals who had not yet retired and for whom the reform had postponed the prospect of receiving pension benefits changed in comparison with individuals in adjacent generations who have not or barely been affected by the reform?

The fact that this 2010 reform created marked inequalities in treatment between generations that were otherwise very comparable has already been used to assess the effects of increasing the retirement age on pre-retirement labour market position. Here, the outcome was that the effect of this postponement initially merely extends the situations in which the individuals found themselves before the shift in retirement age: senior citizens who were already not in employment await their new retirement age without any change in status, while those who were in employment remain there (Dubois & Koubi, 2017; Rabaté & Rochut, 2020). This puts into perspective the idea that raising the retirement age is entirely carried over into higher unemployment and would therefore have no financial benefit (there is indeed additional employment), but also the opposite optimistic idea of an immediate effect that would cause the entire age-based employment rate profile to shift by the same amount and at the same speed as the retirement age, which would maximise its financial benefit. If there were to be an effect (Hairault *et al.,* 2006; Aubert, 2013), it would be more long term.

To explore the effects of the 2010 reform on health before retirement rather than on employment, the authors use administrative data that enable them to measure impacts on several indicators: probability of sick leave, length of that leave, probability of seeing a GP or specialist and, lastly, health-care expenditures. The length of absences and the probability of seeing a GP are not increased, but there is an increase in the probability of these absences and of seeing a specialist, and in the expenditures involved. The interpretations highlighted are the effect on health of the disappointment created by the prospect of having to work for longer, or the fact that individuals who already had a health problem that they were managing in anticipation of their impending retirement would have to consult a medical practitioner sooner when the prospect of that retirement is pushed back.

Given the orders of magnitude, it is not clear that this type of effect on health expenditures or daily allowances would radically change the financial equation for the reforms, in the same way as the carry-over effects on unemployment are not sufficient to say that these reforms ultimately have a neutral effect on the public finances. However, this result does highlight workplace malaise as a resistance factor to these reforms, a point often raised in the debates of recent months.

To finish on a more positive note, the last article, from **Luc Arrondel, Loïc Gautier, Aurélie Lemmonier and Laurent Soulat**, focuses on a positive effect of one aspect of

past reforms. A section of the second COR report (COR, 2004) was dedicated to the right to information. In a system as complex as the French one, aspirations of early retirement can easily be accompanied by apprehension about pension amounts. Up until the 2003 reform, some individual information was of course provided by each regime of which the future retiree had been affiliated, but this information did not give a clear overview of his consolidated entitlements. It was this 2003 reform that initiated the provision of consolidated individual information about entitlements already accrued, which was sent to each individual every five years from the age of 35 onwards. The sending of this information began in earnest in 2007, and two waves of the PAT€R (*PATrimoine et préférences vis-à-vis du TEmps et du Risque* – Savings and preferences regarding time and risk) survey make it possible to assess the impact of this on knowledge of entitlements and concern regarding their amount. These two waves took place in 2012 and 2020, and each contained a module on expectations and preferences regarding retirement. Having two waves with individuals having received information to a greater or lesser extent allows to isolate the effects of that information from the effects of age and those of the period. Age and information both have a positive impact on knowledge of entitlements, which in turn reduces the level of concern. An effect based purely on the period is also observed, but we are unable to say whether this is a trend or relates to cyclical effects. The second wave took place during the COVID-19 crisis and after the structural pension reform bill had just been scrapped. It is possible that this very specific context influenced the state of mind of respondents to that 2020 wave.

Nevertheless, we are concerned here with the issue of individual entitlements. The 2004 COR report distinguished between personal information and general information on the pension system and its outlook. This brings us back to the comments on the article by Frédérique Nortier-Ribordy. Reaching a good level of collective perception regarding the state of the pension system is hindered by another form of complexity other than that relating to the calculation of individual entitlements. The fragmentation of the system and multiplicity of its funding channels, as well as the high sensitivity of the projections to economic growth assumptions, which are themselves highly uncertain, do not favour convergence towards an easily shareable diagnosis to enable a simpler debate. In addition to this, there is also the difficulty of connecting the problem of pensions with other economic and social challenges of the decades to come. This issue helps to form a connection between the issue of pensions and that of dependency, which is a first step. There are many others still to be considered. □

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Dynamic of the Disablement Process in Ageing Populations

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Abstract – This paper aims at projecting the disabled population aged 60 or more, and at identifying the factors that impact those projections. To this aim, we develop a novel methodological approach which allows identifying the role of different parameters (e.g. a change in the probability to remain autonomous, a change in the distribution of survival gains across disability levels) in the forecast of morbidity. This paper focuses on the methodological aspect of this new method. It also provides, as an illustration, a projection of the French elderly disabled population in 2060, relying on the French CARE-M data and on the European data SHARE. It shows that matching the past evolution of the disability-free life expectancy ratio to the total life expectancy requires optimistic assumptions regarding the evolution of the probability to remain autonomous.

JEL: J14, I19, Z18
Keywords: Microsimulation, ageing, elderly disability, long-term care

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In the last decade, most developed countries have experienced an increasing demand for long-term care provision. With increased life expectancy, and ageing baby boom cohorts, many policy experts fear a steep rise in care needs of disabled elderly. By 2050, 10% of the population of OECD countries is expected to be over the age of 80, against 4% in 2010 (Colombo *et al*., 2011). This has prompted researchers to develop models to quantify the extent of the additional care needs. In the US, the Dynamic Simulation of Income Model (DYNASIM, Johnson *et al*., 2007; Favreault *et al*., 2015) was the first large-scale dynamic microsimulation model; the later version of the model then allowed modelling individuals' health status. The evolution of the need for informal or formal care is now projected through microsimulation models in Canada (Lifepaths, POHEM models, Hennessy *et al*., 2015), Spain (DemoCare, Spijker *et al*., 2022) or in the UK (PacSim, Wittenberg *et al*., 2020), for instance. The underlying key question was which scenario might prevail between a possible compression or expansion of morbidity, i.e. how the decline in the mortality rate would translate into more or less years of healthy life.

These previous studies can be categorized along two main strands. First, projections inspired by pension projections: they mostly rely on administrative measures of health and depend on socio-economics factors rather than on health characteristics. In these approaches, long-term care needs are bypassed by measures of care use, or by administrative eligibility criteria to current long-term care provision (see Rutter *et al*., 2011, Schofield *et al*., 2018 for surveys; Bontout *et al*., 2002; Duée & Rebillard, 2006; Lecroart *et al*., 2013; Marbot & Roy, 2015 for studies on French data; Hancock *et al*., 2005 for the UK; Fukawa, 2012 for Japan). The main limitation of such modelling is that it remains independent from underlying health changes, sensitive to non-take-up rate and highly influenced by current care provision. Moreover, the use of administrative measures of health makes the results hardly comparable between countries and subject to changes in the disability definition across time. To understand whether developed countries now face a "long-term care time bomb" or not, one must study thoroughly the ageing process underlying the change in long-term care needs. The second strand of the literature uses dynamic microsimulation models, and relies on an epidemiological approach to disability status. Those studies rely on survey data providing information on limitations in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL). ADLs refer to people's daily self-care activities while IADL do not include ADL and refer to activities that are not necessary for fundamental functioning but necessary to let an individual to live independently in a community. This typology makes the distinction between activities implying taking care of the body from those which are not essential but allow living autonomously. The advantage of the use of epidemiological measures, rather than administrative ones, is to include individuals who are disabled but do not seek any allowance. The prevalence of different levels of disability is projected using models which take as inputs the trends of underlying diseases leading to different disability levels. For example, Kingston *et al*. (2018b) project the prevalence of several diseases in the UK using the PacSim model. Ahmadi-Abhari *et al*. (2017) provide a forecast of the prevalence of dementia in the UK using IMPACT-BAM model (see Norton *et al*., 2013 for a review of previous microsimulation models on dementia). Légaré *et al*. (2014) project the disability status of the Canadian population, using LifePaths, or more recently the POHEM model from Statistics Canada. While this approach uses detailed measures of health status and underlying health conditions, mortality remains projected separately – using official mortality projections – and changes in health conditions are not taken into account in the conditional death rates. Life expectancy gains are thus distributed homogeneously to all health states (including autonomy and light to severe disability). This is an important assumption, as elderly disability projections largely depend on the source of life expectancy gains within each health status. To our knowledge, the American FEM model (Leaf *et al*., 2020), estimated using the Health and Retirement Study data, is the only one allowing mortality to be partly determined by disability. In this model, mortality depends on age, race/ethnicity, gender, education, smoking, chronic health conditions, and limitations in IADL and ADL.

This article relates to this second strand of approaches. We propose a microsimulation model to forecast disability in the elderly population, with a novel methodological approach allowing to identify the role of different parameters in the morbidity forecast. We focus on the dynamics of the process of disablement at older ages, i.e. the flow onto disability states rather than the stock of elderly disabled individuals. Our approach relies on theoretical scenarios regarding the evolution of the transitions between states. Thus, our approach is complementary to that of Leaf *et al*. (2020), who rely

on the projected evolution of some diseases to forecast the evolution of mortality.

The first section of the article presents the main steps of our methodological approach: estimating the transition rates between disability states, building scenarios and projecting elderly disability. A central feature of our microsimulation model is that it allows several options (and corresponding parameters) to allocate mortality decreases and to adjust the transitions between disability states depending on the considered scenarios, hence allowing identifying the effect of a parameter in a projection. The second section provides an illustration of its application, with a projection of the French elderly disabled population in 2060 under a few scenarios. We rely on the projections of the French National Institute of Statistics and Economic Studies (INSEE) for mortality, on the CARE-M survey, a French cross-section survey of elderly population, to measure the prevalence of disability, and on the European Survey of Health, Ageing and Retirement in Europe (SHARE) to estimate the probabilities of transition between health states. The projection is carried out in four scenarios which correspond to different ways to allocate survival gains across disability states. We also consider the effect of an increased probability of remaining autonomous. Our baseline scenario relies on a standard hypothesis regarding the life expectancy evolution in France, and on assumptions regarding life expectancy gains which are similar to those made in previous studies (Lecroart *et al*., 2013; Marbot & Roy, 2015; Roussel, 2017). We show that those assumptions are pessimistic, regarding the evolution of disability-free life expectancy gains, and lead to projections that go against the evolution of the disability-free to total life expectancy ratio observed in the past. On the other hand, we highlight that matching the past evolution of this ratio requires an optimistic assumption regarding the evolution of the probability to remain autonomous.

1. Microsimulation of the Disablement Process

The point of departure of the microsimulation is the distribution of the population of interest (here the population aged 60 and over) by disability states. Then, the method relies on the following steps:

1. We estimate transition probabilities from one state to another (Section 1.1)
2. We use external projections to estimate death probabilities by age and gender (Section 1.2)
3. We decide how to split death probability decreases between disability states (Section 1.3)
4. We adjust transitions to other states than death (Section 1.4)
5. We choose how to attribute disability states to new elderly, the 60 years old (Section 1.5)

We present alternative choices for these steps, to obtain different scenarios about the evolution of the elderly population.

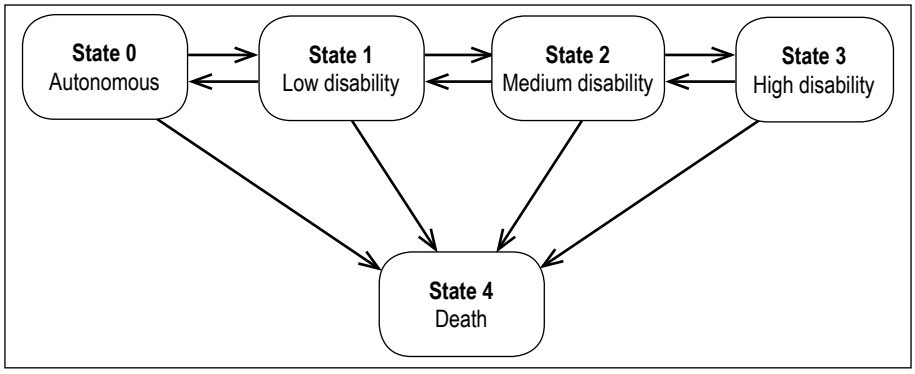
We define five disability states relying on the epidemiological definition of Barberger-Gateau *et al*. (2000) and Pérès *et al*. (2005). It provides a more flexible tool for disability projection than an administrative measure, which relies on being recipient for disability allowances.

The study of disablement process requires making a trade-off between the statistical precision of the estimation and the ability to describe the population trajectories. Moreover, it requires building a disability scale, based on epidemiological evidence that the scale is relevant from the point of view of the aging process and loss of autonomy process. Most studies consider various combinations of functional limitations, IADL and ADL limitations, but there is no gold standard for the measure of the disability process, and the scale chosen varies from one study to another. Here, we choose to follow Pérès *et al*. (2005), whose scale reflects a progressive loss of autonomy. Thus, we consider a total of 4 disability states plus a last state being death: State 0 (autonomy) consists in having no limitation; State 1 (low disability) is having at least one Rosow's functional limitation (Rosow & Breslau, 1966); State 2 (medium disability) is having at least one functional limitation and one IADL limitation (Lawton & Brody, 1969); and State 3 (high disability) is having at least one functional limitation, one IADL limitation and one ADL limitation (Katz *et al*., 1970). State 4 is death.[1]

The Rosow functional limitations (Rosow & Breslau, 1966) include difficulties with: walking 100 meters, climbing one flight of stairs and lifting or carrying weight over 5 kilos. Instrumental activity daily living (IADL) limitations (Lawton & Brody, 1969) include: difficulties with phone call, shopping, taking medications and managing money. For women, it also includes preparing hot meal and doing work around the house. Activity daily living (ADL) limitations (Katz *et al*., 1970) include difficulties with: bathing or showering, dressing, using the toilet, getting in or out of bed, eating, cutting up food. We sum up possible transitions between those different states in Figure I.

1. More details on the definition of disability states in this article and in previous studies are in Appendix.

Figure I – **Transitions between disability states and death**



1.1. Transition Probabilities Between Disability States and Death

We consider that, in each state i (0 to 3), an individual has a non-zero probability to die (i=4). We also allow for transitions in both directions, reflecting that remissions can occur. However we only authorize transitions from one state to the closest other, or to death: for example an individual in state 1 can only switch to state 0, to state 2, or to death (cf. Figure I).

We estimate the probability that an individual switches from one disability state i in $t-1$ to another state j in t, conditionally to his/her disability state in $t-1$ and observed characteristics X. Such a Markovian process is estimated through a multinomial logit model[2] (Equation 1).

$$\frac{P(Y_t = j \mid X_{t-1},\ Y_{t-1} = i)}{P(Y_t = k \mid X_{t-1},\ Y_{t-1} = i)} = \exp(X'_{t-1}\kappa_{ij}) \qquad (1)$$

with Y_t the state observed in t, I in {0, 1, 2, 3}, j and k in {0, 1, 2, 3, 4}and k different from j. κ_{ij} is the conditional probability to switch from one state i to state j. Individual characteristics, denoted by X_t are age and gender. Note that the subsequent disability projection might be improved by adding control variables.

The estimated marginal effects at the mean can be presented as follows. For each age a and gender g, the $P|_{a,g}$ matrix describes the probability to switch from state i to state j, such that:

$$P|_{a,g} = \begin{pmatrix} P_{0,0} & P_{0,1} & - & - & P_{0,4} \\ P_{1,0} & P_{1,1} & P_{1,2} & - & P_{1,4} \\ - & P_{2,1} & P_{2,2} & P_{2,3} & P_{2,4} \\ - & - & P_{3,2} & P_{3,3} & P_{3,4} \end{pmatrix}$$

Some transition probabilities are not presented because they are considered as not "allowed", such as $P_{1,3}$. However, we observe in the data a few cases of transitions which are deemed impossible in the model. When we observe "impossible" transitions, we re-assign the final state to the closest state allowed. For example, if we observe a transition from state 1 to state 3 between $t-1$ and t, we re-assign the individual to state 2 in t.

We estimate first the initial $P_0|_{a,g}$ matrix from observed data. We then calibrate this matrix on observed death probabilities to obtain a $P_0^C|_{a,g}$ matrix. Thereafter, at each time t ($t > 0$), the matrix is calibrated on forecasted death probabilities and according to several scenarios. Thus, matrices include the calibrated probabilities P^c of switching from state i to state j. Such matrices run from 2015 (t=0) to 2060 (t=45), thus, there are 46 P^c matrices.

1.2. Death Probabilities by Age and Gender

We estimate the unconditional calibrated death probability $P^C_{t,,4}$ using the demographic assumptions made by the French national institute for statistics for its population projections (Blanpain & Chardon, 2010).[3]

These projections provide death probabilities by age and gender at each time. We use those death probabilities to calibrate our death probabilities $P^C_{t,,4}$ by gender and age at each time t (with the age and gender indices implicit here and in the notations below).

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2. The multilogit model assumes the Independence of Irrelevant Alternatives (IIA), according to which adding an option does not change the odds ratios. Since we only allow transitions to the closest states, it is not possible to increase the number of options. Thus, this assumption is not an issue in our model.

3. These projections simulate, for each year up to a projection horizon, the number of men and women of each age, based on assumptions on the evolution of fertility, mortality and migration. Various scenarios are explored around a central scenario. In particular, the "young population" and "elderly population" scenarios use assumptions that lead, respectively, to the lowest and highest proportion of people aged 60 or over. Compared to the central scenario, death probabilities are lower at each age in the "elderly population scenario", and higher in the "young population" scenario, hence an older and a younger population, respectively.

1.3. Calibration of Death Probabilities by Age, Gender and Disability State

At each time t, we allocate the calibrated overall death probability $P^{C}_{t,.,4}$ (i.e. regardless of the initial disability state) to conditional death probabilities $P_{t,i,4}$ (i.e. conditional on the initial disability state i, with $i \epsilon \{0, 1, 2, 3\}$). The calibration relies on a parameter, $\lambda \epsilon [0, 1]$ whose value is different according to the way death probabilities attenuation are allocated. We test three hypotheses regarding the allocation of unconditional death probabilities to conditional death probabilities: The first one assumes a homogeneous reallocation ($\lambda = \lambda^{h}$). The second and third assume an heterogeneous reallocation with either all the death probabilities attenuation assigned to the most autonomous states, states 0 and 1, ($\lambda = \lambda^{a}$) or assigned to the most disabled states, states 2 and 3 ($\lambda = \lambda^{d}$). We detail the three hypotheses below.

1.3.1. Homogeneous Allocation of the Decrease in Death Risks

The first hypothesis consists in allocating the decrease in death probabilities homogeneously to all disability states. It reflects a situation where the decrease in the overall death probability is due to a proportional decrease in death probability in each initial state. Importantly, it means that the odds ratios remain constant. In what follows, we use this hypothesis as a benchmark because it is the easiest to combine with the other hypotheses we made, and it is also a benchmark in other studies (see models cited by Comas-Herrera *et al*., 2006 for example). Indeed, this assumption is the implicit one in all models that project first the death probability then apply the prevalence of the disability states to alive individuals. In these models, the prevalence of disability by age and gender remains constant over time. More recent models, such as the one presented by Kingston *et al*. (2018a) apply more refined prevalences for each dependency state depending on the scenario. While usual, this scenario is nonetheless pessimistic regarding the recent years. Indeed, it implies that a decrease in mortality at a given age leads to a proportional increase in the probability of disability (i.e. to be in states 1, 2 and 3) at this age. Overall, because of population ageing, this translates into a higher proportion of life spent in disability than in good health. In other words, the population ages but its probability to be dependent at each age remains constant.

Following this hypothesis, we homogeneously weight all the transition probabilities by a λ^{h} factor at each time. Hence, at each time $t \in [0,45]$, we have:

$$P^{C}_{t,.,4} = \lambda^{h}_{t} \frac{N_{t,0}.P_{t,0,4} + N_{t,1}.P_{t,1,4} + N_{t,2}.P_{t,2,4} + N_{t,3}.P_{t,3,4}}{N_{t}} = \lambda^{h}_{t} \frac{N_{t}.P_{t,.,4}}{N_{t}} \quad (2)$$

with $P^{C}_{t,.,4}$ the unconditional calibrated death probability at time t. We note N_{t} the total population in t and $N_{t,i}$ the population initially in the disability state i in t, for any disability state 0, 1, 2, 3.

Note that Equation 2 is equivalent to:

$$\lambda^{h}_{t} = \frac{P^{C}_{t,.,4}}{P_{t,.,4}} \quad (3)$$

Thus, λ^{h}_{t} is the ratio between the calibrated and uncalibrated death probability.

1.3.2. Heterogeneous Allocation of the Decrease in Death Risks

The second and third hypothesis, respectively "survival gains in autonomy" and "survival gains in disability", correspond to reallocating all the decrease in death probabilities either toward the most autonomous individuals (i.e. those in states 0 and 1) or toward those in the highest disability states (states 2 and 3).[4] These two extreme hypotheses are: *i)* A situation where death rate reduction is only due to a decrease in death risk for the most autonomous persons (for example, if the number of lethal road accidents decreases); *ii)* A situation where death risks decrease among disabled individuals only (for example, if the survival rate of people suffering from Alzheimer's increases because of medical progress). Those "extreme scenarios" show, other things being equal, the maximum magnitude that the reallocation of death probability decreases can have on the evolution of the number of dependent elderly and on morbidity. More balanced scenarios could define parameters that change the odds ratios between the four conditional probabilities $P_{t,i,4}$.

In the "survival gains in autonomy" scenario, any decrease in death probability entirely translates into a decrease in death probabilities among the most autonomous individuals (states 0 and 1). Thus, death probabilities do not change for those in the most disabled states (states 2 and 3).[5]

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4. Death probabilities are gender and age-specific, so that the re-allocations are only happening within each age × gender *cell.*

5. Except in particular cases where there are not enough autonomous individuals of a given age × gender *to absorb the predicted decreases in death probabilities.*

In this scenario:

$$\forall\, i \in \{0,1\} : P^{c}_{t,\,i,\,4} = P_{t,\,i,\,4} - \lambda^{a}_{t}\,.\,P_{t,i,4}$$

$$\forall\, i \in \{2,3\} : P^{c}_{t,\,i,\,4} = P_{t,\,i,\,4}$$

Hence:

$$N.P^{c}_{t,\,.,\,4} = N_0.P_{t,0,4} + N_1.P_{t,1,4} - \lambda^{a}_{t}.\left(N_0.P_{t,0,4} + N_1.P_{t,1,4}\right) + N_2.P_{t,2,4} + N_3.P_{t,3,4}$$

which leads to:

$$\lambda^{a}_{t} = \frac{N_t\,(P_{t,.,4} - P^{c}_{t,.,4})}{N_0.P_{t,0,4} + N_1.P_{t,1,4}}$$

with λ^{a}_{t} the ratio between survival gains and death rates of the most autonomous.

In the "survival gains in disability" scenario, all the decreases in death probability are allocated to the disability states.

$$\forall\, i \in \{0,1\} : P^{c}_{t,\,i,\,4} = P_{t,\,i,\,4}$$

$$\forall\, i \in \{2,3\} : P^{c}_{t,\,i,\,4} = P_{t,\,i,\,4} - \lambda^{d}_{t}\,.P_{t,\,i,\,4}$$

As a consequence, we have:

$$N.P^{c}_{t,\,.,\,4} = N_0.P_{t,0,4} + N_1.P_{t,1,4} + N_2.P_{t,2,4} + N_3.P_{t,3,4} - \lambda^{d}_{t}.\left(N_2.P_{t,\,2,\,4} + N_3.P_{t,3,4}\right)$$

which leads to:

$$\lambda^{d}_{t} = \frac{N_t\,(P_{t,.,4} - P^{c}_{t,.,4})}{N_2.P_{t,2,4} + N_3.P_{t,3,4}}$$

with λ^{d}_{t} the ratio between survival gains and death rates of the most disabled.

1.4. Adjustment of Transitions to States Other than Death

We then adjust transitions to states other than death, i.e. probabilities $P_{t,i,j}$, with $i \in \{0,1,2,3\}$ and $j \in \{0,1,2,3\}$. This corresponds to the path of autonomy loss, or recovery, if $j < i$.

By definition, for each initial disability state i, the sum of probabilities to move to all final states j has to sum to one, i.e.:

$$\forall\, \mathrm{t},\ \forall\, i \in \{0,1,2,3\}:$$

$$P_{t,i,0} + P_{t,i,1} + P_{t,i,2} + P_{t,i,3} + P_{t,i,4} = 1$$

with $P_{t,i,j}$ the probability to move from state i to j at time t.

In turn, calibrating conditional death probabilities induces to modify other probabilities to keep the sum of probabilities equal to 1:

$$\forall\, t, \forall i \in \{0,1,2,3\}\ :$$

$$P^{c}_{t,i,0} + P^{c}_{t,i,1} + P^{c}_{t,i,2} + P^{c}_{t,i,3} + P^{c}_{t,i,4} = 1$$

1.4.1. Homogenous Adjustment on Probabilities: Using a β *Factor*

We adjust transitions to states other than death in order to satisfy both constraints presented above. We adjust conditional transitions to death by a β_t parameter, such that, for all initial state $i \in \{0,1,2,3\}$:

$$\beta_{t,i}(P_{t,i,0} + P_{t,i,1} + P_{t,i,2} + P_{t,i,3}) + P^{c}_{t,i,4} = 1$$

which leads to:

$$\beta_{t,i} = \frac{1 - P^{c}_{t,i,4}}{1 - P_{t,i,4}}$$

In the case of an homogeneous calibration of conditional death probabilities, the formula is:

$$\beta_{t,i} = \frac{1 - \lambda_t P_{t,i,4}}{1 - P_{t,i,4}}$$

Such a setting boils down to the assumption that the odds ratios are preserved across transitions other than transitions to death. For a given initial state i, the reduction of $P_{t,i,4}$ induces that all $P_{t,i,j}$ probabilities (to $j \neq 4$) will increase proportionally.

This assumption enables to have a clear benchmark and a scenario easily comparable with our alternative scenarios. This hypothesis is implicitly made in many previous studies. However, we consider it as a pessimistic one. Indeed, while death probability decreases, transitions between other states remain similar, so that the relative risks of being in each disability state at a given age/gender remain constant. Therefore, we present a different assumption, where transition probabilities between disability states (other than death) are treated heterogeneously.

1.4.2. Heterogeneous Adjustment of Transition Probabilities: Example of an Increase in the Probability to Remain Autonomous

Our model allows the manipulation of each probability individually. Here, we turn to the possibility of modifying odds ratios between transition probabilities of individuals in an autonomous initial state. We consider the probability of staying autonomous $P_{0,0}$, which corresponds to the largest share of the observed flows in the data (see Section 2.2.1). We define a parameter α which impacts the probability to stay autonomous in such a way that this probability increases if $\alpha > 1$. Note that $P^{c}_{t,0,0} + P^{c}_{t,0,1} + P^{c}_{t,0,4} = 1$ so we adjust $P_{t,0,0}$ and $P_{t,0,1}$ such as to have:

$$P^{c}_{t,0,0} = \frac{\alpha\left(1 + \dfrac{P_{t,0,0}}{P_{t,0,1}}\right)}{1 + \left(\alpha\dfrac{P_{t,0,0}}{P_{t,0,1}}\right)}\,P_{t,0,0}$$

$$P^{c}_{t,0,1} = \frac{1+\frac{P_{t,0,0}}{P_{t,0,1}}}{1+\left(\alpha\frac{P_{t,0,0}}{P_{t,0,1}}\right)} P_{t,0,1}$$

Thus, we have:

$$\frac{\alpha\left(1+\frac{P_{t,0,0}}{P_{t,0,1}}\right)}{1+\left(\alpha\frac{P_{t,0,0}}{P_{t,0,1}}\right)}P_{t,0,0} + \frac{1+\frac{P_{t,0,0}}{P_{t,0,1}}}{1+\left(\alpha\frac{P_{t,0,0}}{P_{t,0,1}}\right)}P_{t,0,1} + \lambda_t P_{t,0,4} = 1$$

If $P_{t,0,0}$ increases, the path into disability will slow down, because people stay autonomous for a longer period. A physical activity program for the autonomous elderly is an example of a public policy that could lead to such an evolution.

The transition probabilities from disability states 1, 2 and 3 are adjusted in an homogeneous way, following the method explained above.

In the scenarios presented in this paper, we calibrate the α parameter so that the ratio of disability-free life expectancy to total life expectancy at age 65 remains approximately constant (this is the case when α = 1.015) or increases (when α = 1.03). The credibility of this choice is discussed in the Online Appendix S1 (link of the Online Appendix at the end of the article). This working hypothesis corresponds to a high increase in the probability to stay autonomous, that may not be plausible given the trends observed in the past.

1.5. Assignment of a Disability State to Future Elderly

As our projections begin with a population aged 60 years, we need to assign an initial disability state to the newly 60 years old individuals who are simulated in our model. This assignment is made assuming that the prevalence of disability for the newly 60 years old decreases at the θ rate. Thus, considering that $S_0^{t_0}$ is the share of autonomous individuals in t=0, the share of elderly people with long-term care needs (states 2 and 3) at time t is computed so that:

$$1 - S_0^t = (1-\theta)^{t-t_0} \cdot \left(1 - S_0^{t_0}\right)$$

Using SHARE data (waves 1 to 6), we estimate that θ is equal to 0.1. We keep this parameter constant through time.

1.6. Summary of Alternative Assumptions

Our microsimulation model allows making projections of the elderly disabled population under different scenarios, by combining the options to allocate the death probability decreases and to adjust the transitions to disability states other than death. These options and the corresponding parameters are summed up in Table 1. Comparing two scenarios that differ only in one parameter enables evaluating the weight of the parameter on the projection results.

2. Application: A Projection of the French Population in 2060

This section provides an illustration of the implementation of our model. We project the evolution of the French elderly disabled population, and explore the way each parameter affects the results. Our application relies on two surveys: The French survey CARE-M (2015) gives the initial prevalence of disability in the French population in 2015, and the European panel survey SHARE (2004 to 2017) the transition probabilities used to project the evolution of the French elderly disabled individuals in the population (see Box). We adjust our model to fit with the mortality forecast of the French National Institute of Statistics and Economic Studies (INSEE).

2.1. Scenarios

We present five scenarios which result from different combinations of the options summarized in Table 1.

In the baseline scenario, we project the number of individuals in each disability state considering an homogeneous allocation of mortality by initial disability state. We then homogeneously adjust the other transitions. In this scenario, the sources of life expectancy gains are not specific to individuals in a particular state of disability: it could result, for example, from an overall increase in investments made in hospitals, not targeting specific services.

Table 1 – **Summary of the options to define scenarios**

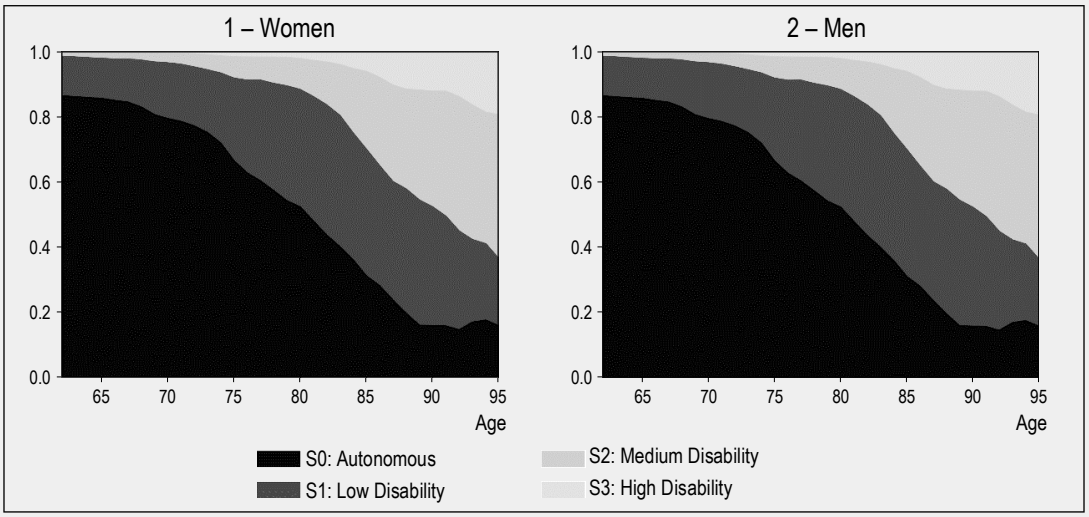
Options for allocating the death probability decrease to initial disability states ($P^{C}_{t,i,4}$)		
Homogeneous allocation (λ)	Allocation to autonomous states (λ^{α})	Allocation to disabled states (λ^{d})
Options for the adjustment on transitions other than death ($P^{C}_{t,i,j}$, $j \neq 4$)		
Homogeneous adjustment (β)	Heterogeneous adjustment (α)	

Box – **Data**

CARE-M survey :

The “Capacités, aides et ressources des seniors - Ménage” (CARE-M, Abilities, help, and wealth of the elderly - household) survey was collected in 2015 by the Ministry of Health. It is representative of the population aged 60 and over, living in ordinary housing (i.e. not in care or residential facilities for the elderly). This survey provides information on the socioeconomic characteristics and health of about 10,000 individuals. We use this data to measure the initial prevalence of disability by age and gender. We apply the weights provided in the survey, in order to account for the oversampling of individuals in bad health. Thus, the estimated prevalences are representative by age, gender and disability state.

Figure A – **Disability states by age in France**



Sample: All elderly aged 60 and over, living in the community in France, respondent to the health questionnaire. Figure A-1 is based on a sample of 6,519 women and Figure A-2 of 4,109 men.
Source: CARE-M, 2015.

Figure A shows that for both gender, the share of those who remain autonomous is higher than 80% at age 60. At age 90, 38% of men and 18% of women are autonomous. The higher prevalence of disability among women is partly explained by the well-known fact that women survive longer with disability than men.

SHARE :

The European Survey of Health, Ageing, and Retirement in Europe (SHARE) (Börsch-Supan, 2020) is a panel database providing information on the population aged 50 and over, living in one of the 21 European countries included in the survey. The first wave was collected in 2004/2005.

We use data from waves 4, 5 and 6 (respectively conducted in 2011, 2013 and 2015). We restrict our sample to individuals from countries surveyed in waves 4, 5 and 6, living in ordinary housing, who answer questions on health and are observable at least in two consecutive waves (i.e. 4 and 5 or 5 and 6). Due to these restrictions, we consider individuals from 13 countries: Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, Netherlands, Slovenia, Spain, Sweden and Switzerland. Including those countries in the sample instead of France allows us to measure a large range of disability states, while keeping a sufficient statistical power.

The target population (for the first wave) is people born in 1954 or earlier and their partner if any, independently from his/her age. Health questions are slightly different in SHARE and in CARE-M.

We select, as in the CARE-M data, the elderly aged 60 and over. We rely on SHARE data to estimate the $P|a,g$ matrix, the probability to switch from state i to state j, for each age a and gender g. We do not use SHARE individual weights, as probabilities are conditional on age, gender and country. Those transition probabilities are then calibrated to match mortality forecasts, as described in Section 1.2.

The Online Appendix S2 provides additional information regarding SHARE data, our sample and the choices we made to harmonize the SHARE and CARE-M datasets population projections.

We use the French National Institute of Statistics and Economic Studies (INSEE) mortality projections in order to align our microsimulation model with credible demographic targets (Blanpain & Buisson, 2019). We rely on the projections from 2013; more recent ones are available but they were made later than the year at which we measure initial prevalence, in 2015. We consider the demographic central scenario, which corresponds to the standard population projection. The underlying hypotheses in terms of life expectancy, fertility and migration are detailed in Table A. We use the age×gender death probabilities to calibrate death probabilities $P^{C}_{t,.,4}$ by gender and age at each time t. ➔

Box – *(contd.)*

Table A – **Demographic assumptions from 2015 to 2060**

	Young population	Central population	Old population
Life expectancy Women	88.6 y.o.	91.1 y.o.	93.6 y.o.
Life expectancy Men	83.5 y.o.	86.0 y.o.	88.5 y.o.
Fertility index	2.1	1.95 from 2015	1.8
Net migration	+150,000	+100,000	+50,000

Note: Demographic assumptions underlying the young population imply that women's (resp. men's) life expectancy is 88.6 years old (resp. 83.5); fertility index is 2.1 and net migration is 150,000 individuals.
Source: Blanpain & Chardon (2010).

On the contrary, the "autonomy" and "disability" scenarios are extreme cases of death probability decreases resulting from targeting particular populations (either in good health or in bad health). For example the "autonomy" scenario could correspond to a situation where a national prevention campaign aims at detecting breast cancers among women. It raises life expectancy of individuals who are relatively autonomous. On the other hand, the "disability" scenario could reflect the decision to invest in the care of individuals affected by the Alzheimer disease, or in research for treatments. Technically, both scenarios correspond to a different allocation of the decrease in death probability, and a related change of the parameter. Note that this approach is more flexible than that of Leaf *et al*. (2020), who uniformly apply a "reduction factor" to death probabilities to capture the effect of medical innovation. On the contrary, we allow here death probabilities to vary depending on the initial disability state.

The last two scenarios, "remain autonomous", consist in increasing the probability to remain autonomous, while keeping other parameters constant. It could correspond for example to a national campaign fostering physical activity among the elderly. The "Remain autonomous scenario – 1.5% increase" consists in setting the annual increase in the probability to remain autonomous to 1.5%. In this setting, the ratio disability-free life expectancy over total life expectancy (hereafter DFLE/LE) at age 65 remains approximately constant in our simulations. The "Remain autonomous scenario – 3% increase" relies on a 3% increase of this probability.

The scenarios and assumptions made for each of them are presented in Table 2, and a reminder of the model parameters is provided in Table 3.

Our baseline scenario relies on rather pessimistic assumptions. In particular, a homogeneous allocation of the death probability decrease across all states implies that, when life expectancy

Table 2 – **Definition of five scenarios**

Scenario	Option 1 Allocation of mortality decrease	Option 2 Adjustment of other transitions
Baseline	Homogeneous	Homogeneous
Survival gains in autonomy	Autonomy	Homogeneous
Survival gains in disability	Disability	Homogeneous
Remain autonomous – 1.5% increase	Homogeneous	Heterogeneous
Remain autonomous – 3.0% increase	Homogeneous	Heterogeneous

Table 3 – **Parameters of the model**

Parameter	Definition	Formula
λ	Weight applied to mortality probabilities	$\lambda = \frac{P_4^{INSEE}}{\sum P_{i,4} N_i}$
μ	Proportion of life expectancy gains attributed to autonomy states	$\mu = 0$ or $\mu = 1$
β	Weight applied to transitions between dependency states	$\beta = \frac{1-\lambda . P_{i,4}}{1-P_{i.4}}$
α	Change in the probability to remain autonomous	$\alpha = 1$ or $\alpha = 1.015$ or $\alpha = 1.03$
θ	Decrease (in %) of the share of dependent 60 years old	Exogenous, $\theta = 0.1$

Note: P_{i4} is the probability to die for someone in dependency state i, N_i the population in state i, P^{INSEE} are INSEE projections for mortality.

increases, it translates into a higher share of disability-free life expectancy.

Such an assumption is implicitly made in several studies, for example those cited by Comas-Herrera *et al*. (2006). It is a key assumption, as elderly disability projections largely depend on the source of life expectancy gains. Here we make this assumption explicit in the model; we then show to what extent this choice impacts the disabled population projection.

2.2. Results

In this section we present the results of our microsimulation model application. We first present transition probabilities estimated using SHARE data, then, the projected evolution of the elderly disabled population under the scenarios defined above.

2.2.1. Transition Probabilities

Table 4 presents the mean probabilities to switch from one disability state to another, conditionally on observed characteristics (age and gender).[6]

Our transition probabilities are estimated on a sample of 13 European countries, which allows us reaching an acceptable statistical power to estimate transitions in a 5-level scale. But this can have several downsides from other points of view. We therefore carry out various robustness tests. Firstly, we test whether this sample is representative of the French case, by comparing the transition probabilities measured for the whole sample and for the sample restricted to French individuals (see Online Appendix S3, section 2). We also want to ensure that our results are not sensitive to specificities of some of the 13 selected countries. A comparison of the baseline transition probabilities with estimates from alternative samples of countries shows that it does not modify our main results (see Online Appendix S3, section 3). We also check that including more control variables in the estimation does not modify those results (see Online Appendix S3, section 4). Finally, we check that, when some transitions to non-nearby states are identified and modified, only a small share of our sample is concerne. We check that our results are robust to those modifications (see Online Appendix S3, section 5).

The disablement process varies across gender. Online Appendix S4 provides additional results, first by splitting the sample between men and women (see Table S4-1 in Online Appendix S4). Gender differentials are more striking for the two highest states of disability, especially regarding death probabilities.

As transition probabilities have changed over the last few years, using old waves of the SHARE data could be detrimental to the estimation of the disablement process. We consider using SHARE oldest waves rather the most recent ones (see Table S4-2 in Online Appendix S4), which only leads to small changes.

2.2.2. Projection of the Elderly Disabled Population

We provide now some illustrations of the results that can be obtained using this microsimuluation model, considering how many elderly disabled individuals are projected until 2060 and how those projections vary by scenario. We use the previously mentioned age×gender-specific transition probabilities, recalibrating death probabilities using INSEE mortality forecasts for each year. For example, the first step consists in recalibrating the 2015 death probabilities to be equal to death probabilities provided in population forecast given by INSEE 2015 from its central demographic scenario.

Figure II shows the evolution of the number of disabled individuals under the baseline scenario, where life expectancy gains are homogeneously reallocated between disabled states. Our projections lead to estimate that in 2060, 2.7 million

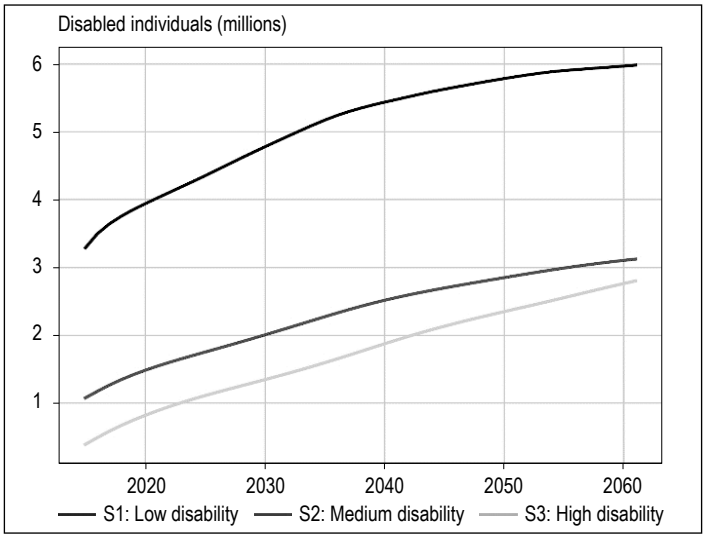
6. As an example, we also present adjusted predictions of our multinomial Logit models for a 70 years old woman and a 70 years old man in the Online Appendix S3, section 1.

Table 4 – **Probabilities of transition between disability states, estimated with SHARE Data**

	Autonomy (S0)	Disability			Death (S4)
		Low (S1)	Medium (S2)	High (S3)	
S0	0.82	0.16	x	x	0.02
S1	0.34	0.36	0.23	x	0.07
S2	x	0.33	0.27	0.26	0.13
S3	x	x	0.27	0.50	0.23

Notes: The estimated probability to remain autonomous is 82%. An individual with low disability (S1) has a 34% probability to recover autonomy (S0), 36% to remain lowly disabled, 23% to become medium disabled (S1) and 7% of dying (S4).
Sample: Elderly aged 60 and over, in one of the 13 countries included (cf. Box), responding to the health questionnaire at least in two consecutive waves. We exclude spouses from the sample.
Source: SHARE waves 4, 5 and 6.

Figure II – **Evolution of disability in the French population aged 60 or more, baseline scenario**



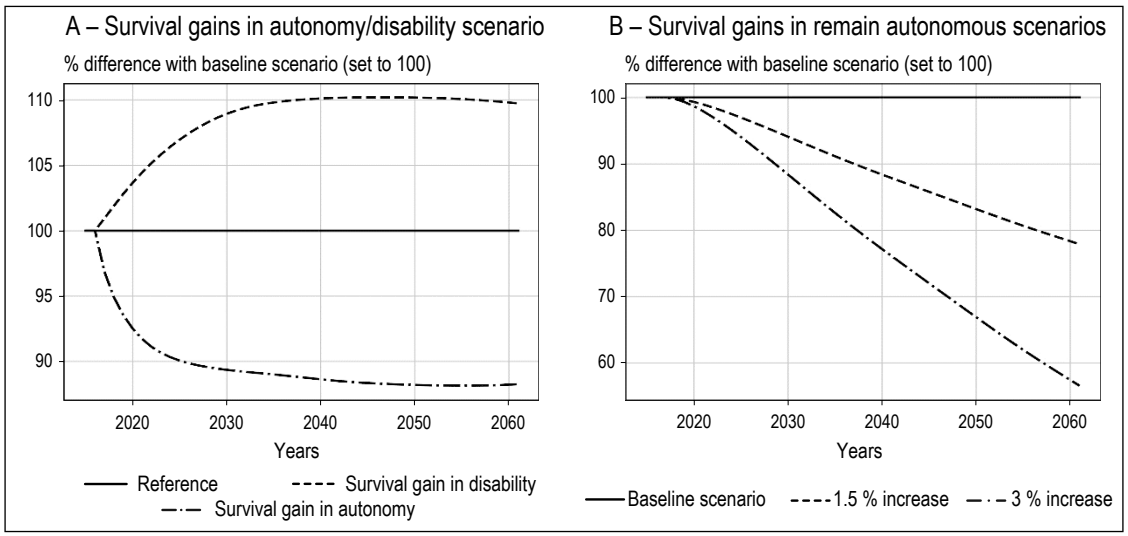
Sample: All elderly aged 60 and over, in one of the 13 countries included (See Table S2-2 in Online Appendix S2), respondent at least in two consecutive waves, and respondent to the health questionnaire. We exclude spouses from the sample.
Source: SHARE Waves 4, 5 and 6.

people will be highly disabled (state 3, meaning that they have at least one functional limitation, one IADL and one ADL). This forecast is more pessimistic than the French projection relying on an administrative approach to disability (for example, Charpin & Tlili (2011) forecast about 2.3 million disabled people). It is consistent with the idea that epidemiological measurement of disability accounts for individuals who would not seek any allowance.

Figure III shows the evolution of the number of disabled individuals (defined as those in states 2 and 3, i.e. with IADL or ADL limitations) among those aged 60 or more across the scenarios. We set the baseline scenario at 100 so that any divergence corresponds to the difference between the projection of a scenario and the baseline scenario.

Firstly, we compare the projection of the baseline scenario to the "survival gains in autonomy" and in "survival gains in disability" scenarios (Figure III-A). The "survival gains in autonomy" scenario leads anticipating 15% less disabled individuals in 2060 than the baseline scenario.

Figure III – **Evolution of disability (IADL or ADL limitations) in the population 60+, by scenario**



Notes: Figure A: Disability includes people in states 2 or 3. In 2060, the scenario "survival gains in disability" leads to a forecast of 1.1 times more dependent individuals than with the baseline scenario. The scenario "survival gains in autonomy" leads to a forecast of 1.11 times less dependent than with the baseline scenario. Figure B: In 2060, the scenario "1.5% increase in the probability to stay autonomous" leads to a forecast of 1.28 times less dependent individuals than with the baseline scenario. The scenario "3% increase" leads to a forecast of 1.81 times less dependent than with the baseline scenario. Mechanically, when we do not modify the probability to stay autonomous, the difference with the baseline scenario is null.

As the death probability of autonomous individuals decreases, because all survival gains are allocated to them, they remain for a longer period in the autonomous state. The projected number of disabled people is smaller than in the baseline scenario. The death probability decreases in the disability scenario leads in 2060 to a population including 10% more elderly disabled individuals than in the baseline scenario. This is due to the fact that the life expectancy of disabled individuals increases. Around 2030, the difference between both scenarios and the baseline remains constant, because of the gradual arrival of the baby-boomers in the states of disability. In the baseline scenario, the number of disabled individuals is important from 2030 onwards, which implies that the difference with both scenarios remains constant afterwards.

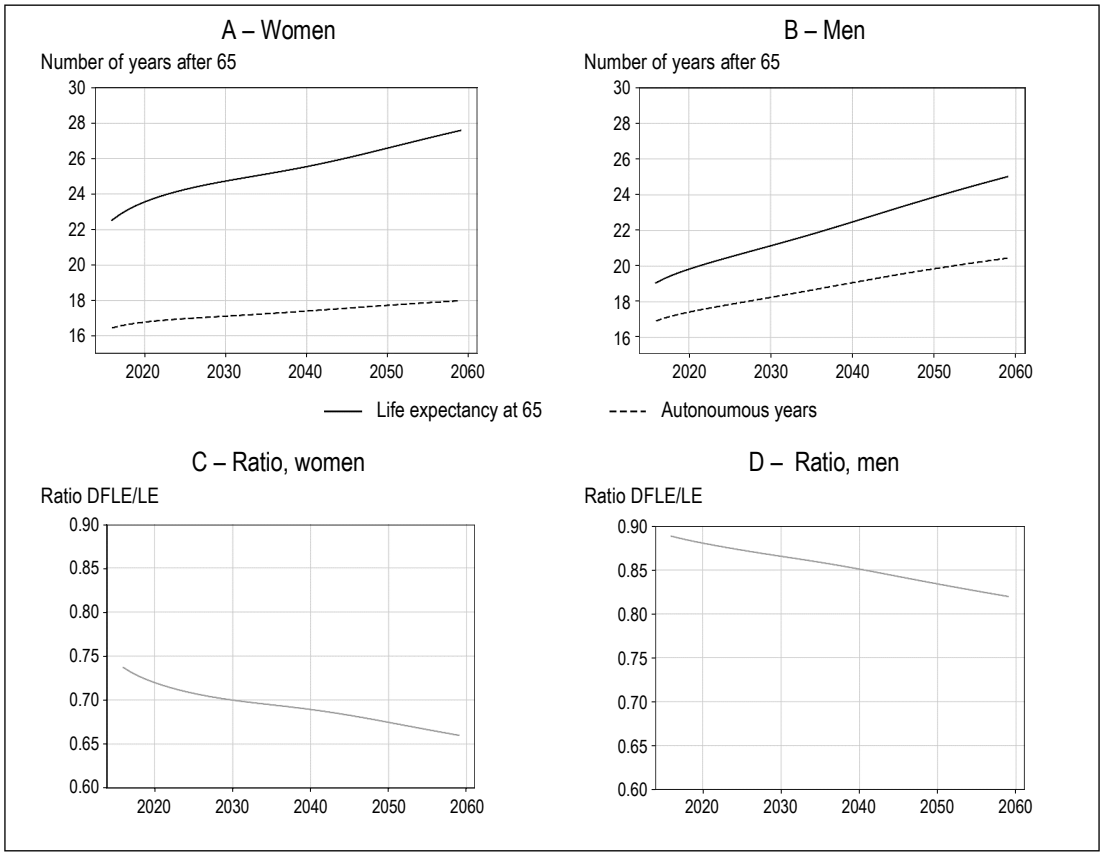
Then, we compare the baseline scenario projections to the "remain autonomous" scenarios (Figure III-B). The first scenario, where we set the annual increase of the probability to remain autonomous at 1.5% (so that the DFLE/LE ratio at age 65 remains approximately constant), leads anticipating 20% less disabled individuals than the baseline scenario, where the probability to remain autonomous is constant over time. Setting the increase in the probability to 3% results in about 45% less disabled individuals.

Those results rely on the demographic assumptions of the INSEE's central scenario. In order to test the sensitivity of our results to the demographic assumptions we rely on, we have adopted alternatively the assumptions of the "young population" and "old population" scenarios of the INSEE's projections (cf. Box and Table A). These assumptions lead to shares of disabled individuals (i.e. in states 2 and 3) which are 12% lower and 20% higher, respectively, than those obtained using the demographic assumptions of the central scenario. These results are presented in the Online Appendix S4.

2.2.3. Projection of the Morbidity Trends

We now turn to the projected evolution of the disability-free life expectancy compared to the overall life expectancy. We compute the disability-free life expectancy to total life expectancy ratio at age 65. Disability-free years are all the

Figure IV – **Overall and disability-free life expectancy at age 65, baseline scenario**



Note: In the reference scenario, disability-free life expectancy for women is around 16.5 years in 2015, rising to 17.9 years in 2060, while total life expectancy varies from 22.5 years to 27.5 years in 2060. The ratio of these two variables was 74% in 2015, rising to 65% in 2060. The disability-free life expectancy, respectively total life expectancy, of men varies from 17, respectively 19, in 2015 to 20.5, respectively 24.7. The ratio therefore falls from 89% to 82%.

years spent in states 0 or 1, i.e. without any IADL or ADL limitation.

Figure IV shows the expected number of autonomous years at age 65 compared to the overall life expectancy at age 65 in the baseline scenario. For men, the projection for 2060 leads anticipating that, on average at age 65, disability-free years will represent 20.5 of the 24.7 years expected to remain to 2060. It corresponds to a DFLE/LE ratio equal to 0.82. For women, in 2060 this ratio lowers to 0.65 as they are expected to live 17.9 disability-free years in the 27.5 years expected.

Those forecasts are relatively pessimistic, in line with the pessimistic assumptions chosen. Indeed, disability-free life expectancy is forecasted to increase less rapidly than life expectancy, especially for women. Previous observations of the trends are the reverse: Cambois *et al*. (2008) show that, between the 1980s and 2002-2003 and for men and women, disability-free life expectancy (considering only severe disability) increased more than total life expectancy.

Several previous studies projecting the evolution of the number of disabled elderly individuals assumed in their central scenario that the DFLE/LE ratio would remain constant (Lecroart *et al*., 2013; Marbot & Roy, 2015; Roussel, 2017).

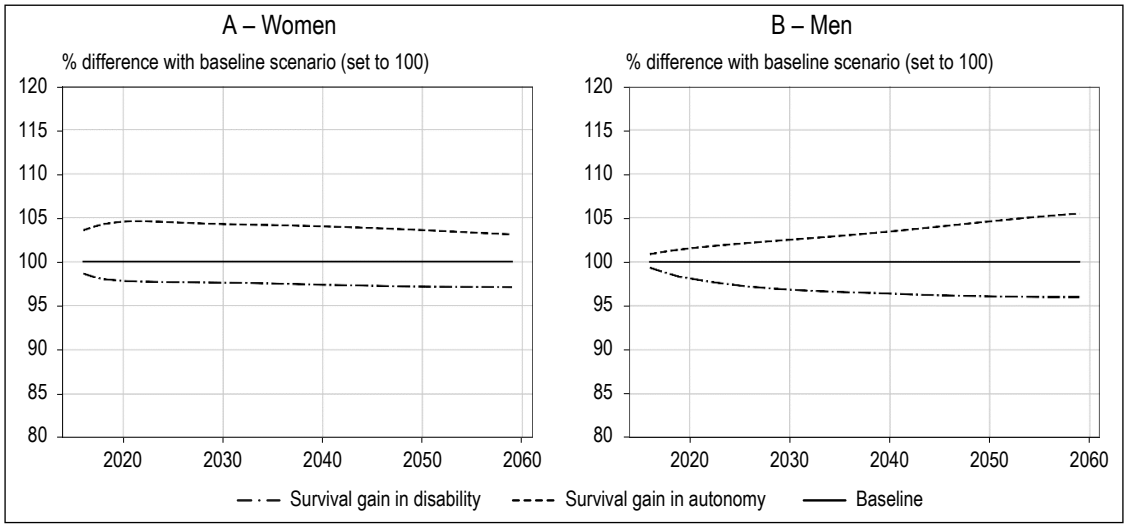
We now examine whether more optimistic assumptions result in a projected DFLE/LE ratio more in line with previous trends and studies.

Figure V presents a comparison of the evolutions of the DFLE/LE ratio with the death probability decreases allocated to autonomy or to disability (the baseline scenario is here again set to 100), separately for women and for men. For men, the scenario in which all the gains are allocated to autonomous individuals leads to forecasting a ratio 5% higher than in the baseline scenario projection (Figure V-B). As disability-free life expectancy increases more rapidly than overall life expectancy, the ratio increases as well. Logically, the scenario in which all the decrease in death probability is allocated to disability results in forecasting a ratio 5% smaller than in the baseline scenario. For women (Figure V-A), the divergence from the baseline scenario is smaller, with a difference of 2 or 3% for each scenario, and less symmetric.

Finally, we examine the DFLE/LE ratio when varying the probability to remain autonomous. For women (Figure VI-A), the increase of 1.5% of the probability to remain autonomous raises the DFLE/LE ratio by 10% in 2060 compared to the baseline scenario. The impact for men (Figure VI-B) is twice smaller, around 5% in 2060. In the scenario where the increase in the probability to remain autonomous is set to 3%, the DFLE/LE ratio is higher by 23% for women in 2060, and 14% for men.

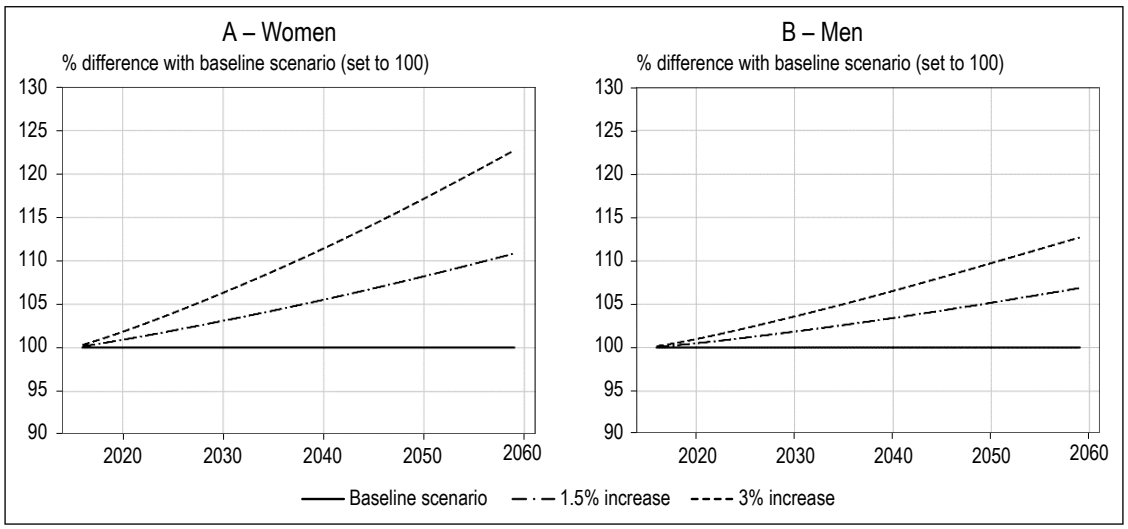
We present the same comparisons for demographic scenarios by measuring, for the "young population" and "old population" scenarios, the DFLE/LE ratio. (see Figure S4-I, in the Online Appendix S4), to illustrate again how the demographic assumptions influence those projections. The "young population" scenario leads to a 4% (resp. 2.5%) higher DFLE/LE ratio among women (resp. men), and the "old population" scenario to a 5% (resp. 2.5%) lower

Figure V – **Disability-free life expectancy to total life expectancy ratio after age 65 by survival gains allocation scenario**



Note: In 2060, considering the "survival gains in autonomy" scenario, the ratio of disability-free life expectancy to total life expectancy is projected to be 5% higher than in the baseline scenario for men.

Figure VI – **Disability-free life expectancy to total life expectancy ratio after age 65 according to the increase in the probability to remain autonomous**



Note: In 2060, considering the "1.5% increase" scenario, the ratio life expectancy in good health over total life expectancy is projected to be 10% higher than in the baseline scenario for women.

ratio for women (resp. men). We conclude that modifying our main demographic assumptions, using different life expectancy forecasts (young, central or old population) does not drastically modify our main baseline scenario results.

* *
*

This article aims at improving the understanding concerning scenarios that might drive a compression or expansion of morbidity. For example, how the decrease in death probability impacts the disability-free life expectancy to total life expectancy ratio, or how the evolution of the prevalence of disability affects this ratio. To this aim, we develop a new methodological approach to project the increase in long-term care needs within ageing populations. A key assumption is related to how life expectancy gains are allocated to the different disability states. We estimate transition rates between several disability states, in order to make this key assumption explicit. The model enables to isolate the effect of each parameter. Therefore, it could be used to estimate the long-run impact on the disabled population of a breakthrough in medicine, a pandemic or a national prevention policy, by assuming which transition probability these events will affect.[7]

In our application study, we project the evolution of the French elderly disabled population in 2060. We use the European panel survey SHARE to estimate the transition probabilities from one disability state to another, and the French survey CARE-M to determine the initial prevalence of each disability state in the French population of elderly aged 60 and over and living in ordinary housing (i.e. not in care or residential facilities).

We show that assumptions to allocate death probability decreases between disability statuses do influence the disability forecast: the projected number of elderly disabled people varies by +/−10% compared to the baseline scenario each year, and the DFLE/LE ratio varies by +/−5%. The assumptions related to the evolution of the probability to stay autonomous have a larger impact on the projection, with a decrease of around −20% of disabled individuals when the probability to remain autonomous increases by 1.5% each year. The DFLE/LE ratio increases by 5% in this case.

Our application has two main limitations. First, the number of explanatory variables used for the estimation is limited, as only age and gender are controlled for. Second, our analysis focuses on individuals living in ordinary housing, i.e. excluding those who live in care facilities, who might present higher degrees of disability. This could lead to an underestimated forecast of the share of disabled. However, this may have only a limited impact, since the share of elderly people living in a nursing home is 4% (Carrère & Roy, 2020). Time spent in a nursing home is also relatively short, with half of the stays lasting less than 1.5 year and three quarters of the stays last less than four years (Fizzala, 2017).

7. *The software package is available upon request.*

More generally, our application highlights that building a plausible scenario requires to work in details on the past evolution of specific parameters, in order to make assumptions on their evolution. Specific hypotheses about the evolution of medical and sanitary care make also possible to build scenarios regarding the evolution of disability. The strength of microsimulation is only marginally exploited in this paper, as we use a limited set of covariates – one could well apply macrosimulation or cell-based simulations instead. But, as a methodological contribution, it shows the potential of this approach. Further research is required to build such scenarios relying on plausible assumptions. Moreover it should be highlighted that those results do not provide answers to the question whether the projected demand for care will be satisfied or not. The decline in the availability of caregivers might limit this goal. Further research regarding the evolution of formal and informal care supply could help to build public policies. □

Link to the Online Appendix:
www.insee.fr/en/statistiques/fichier/7615301/02_ES538_BenJelloul-et-al_OnlineAppendix.pdf

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APPENDIX

LITERATURE AND DEFINITION OF DISABILITY STATES

1 – Measure of Disability in Previous Studies

Our choice of disability scale relies on epidemiological publications studying the relevant measure of the process of loss of autonomy. Since no gold standard exists on this question, this choice varies from one study to another.

Some studies forecasting disability accounted for functional limitations but fewer states were considered. Some of them relied on three states, being "having no limitation", "having limitations" and "death" (Cambois & Robine, 2014); others on four disability states: "autonomy", "functional limitations", "limitation in activity daily living" and "death" (Cambois & Lièvre, 2007; Crimmins *et al.*, 2009).

Several other studies also accounted for five possible states in the disability scale, however with different definitions, excluding fonctional limitations or by considering a larger scope. For example, in Spijker *et al.* (2022), low dependency is defined as having "disability reported but no problems stated in carrying out ADL/IADL", medium dependency as "one ADL and/or any IADL" and high dependency as "at least two ADL". Cai & Lubitz (2007) only rely on limitations in ADL / IADL: low disability consists in having at least one IADL but no ADL, moderate disability is being disabled in one or two ADLs and severe disability is being disabled in at least three ADLs.

2 – Definition of Disability States

Table A2 – **Definition of dependency**

Scale	Name	Due to health problem, have at least one difficulty with:
State 0	Autonomy	None of the mentioned activities
State 1	Rosow limitation	Walking 500 meters
		Climbing one flight of stairs
		Lifting or carrying weight over 5 kg
State 2	IADL limitation	Making telephone calls
		Shopping for groceries
		Taking medications
		Managing money
		For women only: preparing a hot meal
		For women only: doing work around the house or garden
State 3	ADL limitation	Bathing or showering
		Dressing, including putting on shoes and socks
		Using the toilet, including getting up or down
		Getting in or out of bed
		Eating, cutting up food
State 4	Death	

Institutional Long-Term Care Use in France (2008-2015): The Role of Family Resources

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Abstract – The substantial increase in the proportion of very old people in the population has not given rise to a large increase in institutional long-term care (LTC) in France. In this article, we aim to analyse the contribution of individual factors to this trend: age, level of education, gender, type of disability and the family environment. Based on data from the *Handicap-Santé 2008-2009* survey and *Capacités et Aides et REssources des seniors* (CARE) 2015-2016 survey, we estimate the change in the probability that an individual aged 75 or over will be living in an institution based on these various factors. A decomposition shows that the increase in the proportion of very old people and those with severe limitations brings about an increase in overall use, but that the increase is offset by a concomitant increase in family resources to be helped at home. The level of use associated with the various factors did not change significantly. The limited increase in LTC use is explained by a composition effect, linked to an increase in family resources to provide in-home care, but not to a reduced level of LTC use.

JEL: C35, I11, I12, I18, J11, J14
Keywords: ageing, dependency, use of institutional care, in-home care, socio-demographic changes

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The increase in life expectancy and the ageing of Baby Boomers are reflected in an increase in the number and proportion of old people within the population. In 2021, France counted 18 million people aged 60 and over (6.4 million aged at least 75), representing 27% of the total population. By 2050, this proportion is expected to rise to 33%, amounting to 23 million people, with an even greater share of very old people (Algava & Blanpain, 2021). As advancing age increases the risk of dependency (defined as the need of assistance for elementary activities), these demographic dynamics suggest that the number and proportion of dependent old people will also increase (Larbi & Roy, 2019; Ben Jelloul *et al.*, not yet published). Larbi & Roy (2019) estimate that almost 4 million old people in France will be dependent by 2050 (16% of persons aged 60 or over), compared with 2.5 million in 2015 (15% of persons aged 60 or over).

These demographic changes are accompanied by an increase in the number of people living in institutions for old people (EHPA, *Établissement d'hébergement pour personnes âgées*): between 2007 and 2015, this number increased from 657,000 people, with 495,000 of them living in institutions dedicated to dependent old people (EHPAD) (Prévot, 2009), to 728,000 in EHPA (+11%), of which 590,000 living in EHPAD (+18%) (Abdouni *et al.*, 2019; Muller, 2017a). These figures reflect increased need in terms of the number of dependent persons to be accommodated (+91,000); however, the proportion of the population aged over 60 living in EHPAD (3.6%) has remained stable (Carrère & Dubost, 2018). In their projections, Miron de l'Espinay & Roy (2020) estimate the expected population of EHPAD residents to 719,000 people in 2030, then 930,000 in 2050 (intermediate demographic scenario), an increase of around 50% compared with the 610,000 residents in 2019. These projections are based on the assumption that the rate of use of EHPAD will remain stable with regard to age, gender and level of dependency, implying a significant increase in the number of people to be accommodated. The authors also explore scenarios involving more moderate growth in available accommodation. Given the current dynamics with regard to the creation of beds and the targets set by the public decision-maker,[1] it is indeed likely that the coming decades will bring the rationing of EHPAD beds.

Although age and disability are key factors in the use of care facilities (Wolinsky *et al.*, 1993; Hajek *et al.*, 2015), they are not the only factors at play: the availability of potential caregivers and socio-economic characteristics also appear to be decisive (Billaud & Gramain, 2006; Gaugler *et al.*, 2007a; Luppa *et al.*, 2010). Potential changes in these factors must therefore be taken into account when forecasting care needs. In addition, the impact of these determining factors on the use of institutional care may change over time as a result of changes in individuals' behaviour linked to evolving individual preferences or external constraints (public policies, care provision). However, the laws of 20 July 2001 and 28 December 2015[2] encouraged people to remain in their own home, even when needing assistance (Trabut & Gaymu, 2016; Tomassini *et al.*, 2004). This "shift to in-home care" desired by the public decision-maker responds, on the one hand, to the demands of individuals – who express a preference for remaining at home should they need assistance (Eurobarometer, 2007) – and, on the other hand, to manage the costs associated with assisting people with severe disabilities. Indeed, such costs, whether borne by individuals or public funding, would be higher in an institution than at home (Fizzala, 2016; France Alzheimer, 2011; Ratte & Imbaud, 2011).[3] In 2019, according to figures from the Directorate of Social Security, the average cost of being cared for in an institution varies from EUR 28,700 per year for people with a low need for assistance (GIR 4) to EUR 40,000 per year for with the most intense need for assistance (GIR 1); the figures for being cared for at home are EUR 7,500 and EUR 32,900, respectively.[4] This encouragement to be cared for at home resulted in few beds being implemented within institutions (Muller, 2017a), but was not accompanied by a significant shift towards in-home care (Carrère *et al.*, 2021). This resulted in an increase in EHPA bed occupancy rates (Muller, 2017b) and the emergence of waiting lists. This lack of available beds within institutions brought about a change in the behaviour of individuals when it comes to care.[5] The projection assumption based on the stability of the use of EHPA therefore needs to be tested.

In this article, we propose an evaluation of the role of factors other than age and disability in the

*1. In the Social Security Financing Bill (*Projet de loi de financement de la sécurité sociale – PLFSS*) for 2022 the creation of EHPAD beds is limited to 2,000 per year from 2024.*

2. Law on the handling of the loss of autonomy *of elderly persons and the personal autonomy allowance (2001) and Law on the adaptation of society to ageing (2015).*

3. It should be noted, however, that this does not take account of intra-family transfers taking the form of a service, the monetary valuation of which significantly increases the cost of homecare.

4. See the evaluation report on social security policies ("independence" branch), annexed to the Social Security Financing Bill for 2022 (PLFSS 2022).

5. This study uses data from before the COVID-19 crisis. According to Miron de l'Espinay & Ricroch (2021), the average EHPAD occupancy rate fell by 6% between January 2020 and January 2021.

use of EHPA. We analyse the mechanisms linked to the effect of changing population characteristics (composition effect) and those linked to the effect of this change on the relationship between those characteristics and the use of institutional care. In order to do so, we use an analytical framework (de Meijer *et al.*, 2015), which we apply to France using data covering the years 2008 and 2015. In this context, the change in the use of EHPA is considered as the result of a change in the nature of prevalent disabilities and the demographic, family and social characteristics of individuals. We decompose that change to analyse the respective contribution of changes in the composition of the population in view of these factors and that of changes in the way these factors are linked to the use of EHPA. This decomposition allows analysing whether such links changed over the period and whether they tended to accentuate or moderate the impact of the change in composition. In addition to identifying the above mechanisms, this study also points to additional data that would be useful inputs for projection exercises. The article provides a literature review in Section 1. In Section 2, we describe the data and analysis strategy allowing for the identification of the dynamics underlying the change in the probability of living in an EHPA. The results are presented in Section 3, discussed in Section 4, and followed by a conclusion.

1. Literature Review

1.1. Factors Affecting the Provision of Care in Institutions rather than at Home

There has been a great deal of research into the use of institutional long-term care in recent decades. Health status appears to be the main factor due to its impact on the risk of needing assistance on a daily basis (Arnault, 2015; Carrère, 2021). The presence of functional limitations increases the probability of living in institutions (Wolinsky *et al.*, 1993; Hoerger *et al.*, 1996; Nihtilä *et al.*, 2008; Hajek *et al.*, 2015; Carrère & Jusot, 2020; Carrère, 2021), but with variations depending on their severity and nature. Cognitive limitations (Hoerger *et al.*, 1996; Nihtilä *et al.*, 2008; Luppa *et al.*, 2010), their combination with activity limitations (Gaugler *et al.*, 2007b) or their sudden occurrence (Laferrère *et al.*, 2013) increase the probability of living in institutions. Gramain (1997) shows that the probability of living in institutions is higher where cognitive functional limitations occur prior to physical or sensory functional limitations. This means that the degree to which they need assistance is greater for those living in an institution than those living in their own home (see Fuller-Thomson *et al.* (2009) for the United States; Calvet & Pradines (2016) for France). Health status also has an indirect impact on the use of institutional care: its deterioration can accentuate feelings of insecurity, isolation or even the feeling of being a burden on the family group (Böckerman *et al.*, 2012), and causes old people to rethink their individual preferences with regard to the types of care available to them.

Looking beyond the care needs associated with severe and complex levels of disability, the probability of living in institutions increases with age for men, or where there is little opportunity to benefit from informal care (Bonsang, 2009; Freedman, 1996). All else being equal, there is a positive correlation between age and the risk of living in an institution. Alterations in certain functions, the occurrence of certain diseases, feelings of insecurity at home or actual or perceived isolation are all factors associated with advancing age that contribute to people moving into an institution. People may also simply be resigned to living in an institution as they get older. Age therefore captures care needs, as well as potentially certain factors associated with individual preferences. The change in the proportion of very old people among the old population, due to the ageing of successive generations, is expected to lead to a change in the proportion of the population living in institutions.

There are more women living in institutions than men. Due to their greater longevity, they are more likely to reach ages where the risk of severe disability is high and where they have a greater risk of being widowed and therefore finding themselves alone when they need assistance. However, empirical results reveal that, all else being equal, women are less likely to be living in an institution than men. Moreover, an increase in the probability of living with a partner has been observed due to a decrease in mortality among men, which undoubtedly has an impact on the proportion of the population turning to institutional care (Bonnet *et al.*, 2021). Therefore, whether a person grows old with a partner or alone and whether or not they have children, brings about significant changes in the probability of remaining in their own home in the event of the deterioration of their functional state (Van Houtven & Norton, 2004). In this regard, family caregivers now appear to act as a key factor in whether or not old people with severe disabilities can remain in their own home

(Fontaine & Juin, 2020). Finally, gender can also capture particular preferences or resources influencing the type of care chosen. For example, Low & Altman (1992) developed the concept of place attachment and the literature shows that women tend to be more attached to their place of residence (Shen *et al.*, 2004). They are also more likely to be involved in domestic chores within their home and are therefore more able to remain at home, even if they live alone.

The impact of income on the use of institutional care is not clearly established in the literature and, to our knowledge, there are no recent studies based on French data that explore the link between income and the probability of living in institutions. The significant impact of social category highlighted by Désesquelles & Brouard (2003), who show that blue-collar and white-collar workers have a higher probability of living in institutions than executives or craftspeople, traders and company managers, partially captures an income effect and very likely also social differences concerning the level of education, health status and behaviour when it comes to accessing care or assistance that are not otherwise controlled for. The inherent impact of income is *a priori* ambiguous: although a higher income makes it easier to shoulder the cost burden associated with living in an institution, which is generally higher than that associated with remaining at home (Quentin *et al.*, 2010; Fizzala, 2016),[6] it also allows for the provision of more comprehensive care in their own home – for example greater use of professional personal assistants, the provision of services that allow living at home when functional difficulties occur (meals on wheels, remote alarm) or housing arrangements[7] that allow people to grow old in ordinary housing (Laferrère *et al.*, 2013). According to Garber & MaCurdy (1990) income has a smaller impact on whether or not a person moves into an institution than personal wealth and in particular the fact of owning one's own home. This conclusion could very definitely apply to France: added together, the social and fiscal benefits that partly finance facility expenses (personal autonomy allowance, housing benefit, tax credits, but not including social housing benefits) appear to be only very slightly influenced by income and their amount is limited, covering only 18% of accommodation costs on average (Boneschi & Miron de L'Espinay, 2022). Many residents therefore finance some of their accommodation costs from their own wealth. Studies also show the existence of a degree of reluctance among family members to finance the homecare needed to face incresead dependency, in an effort to preserve that wealth. This may lead relatives to prioritise in-home care to avoid losing a share of their inheritance to the expenses. Lockwood (2018) demonstrates that people aiming to hand down their wealth increase their savings and decrease their expenditure on LTC (including insurance). The links between income, wealth and behaviour when it comes to the use of institutional care therefore appear to be relatively complex and largely unexplored, particularly in the context of French institutional care.

1.2. Predicting Levels of Use of Institutional Care

In order to anticipate future care needs, several methods have been developed with a view to taking as many determining factors as possible into consideration: weighting methods (Kemper & Murtaugh, 1991; Murtaugh *et al.*, 1990) and microsimulation (Miron de l'Espinay & Roy, 2020; Dick *et al.*, 1994; Kemper *et al.*, 2005). The latter use the relationships observed between these determining factors (on a given date based on surveys that are representative of the population) and the use of institutional care to forecast the number of people needing care in the future. The exercise requires to model future changes in the determining factors under consideration. While it is quite easy to project the age and sex structure of the old population by socio-economic, family and disability characteristics are more difficult to predict. These models often also estimate the change in LTC needs in the event that behaviour remains stable. However, changes in behaviour pose a significant challenge when adjusting the political response to meet demand: if the number of beds in institutions are to be limited in the future, the offer must be accompanied by a change in behaviour and preferences towards being cared for in one's own home. In France, according to the DREES barometer, two-thirds of French people have no plans to live in an institution (BVA, 2018). Among people aged 65 and over, the proportion of people reluctant to be cared for in an institution increased from 25% in 2002 to 42% in 2019.[8]

The reasons behind these changes are yet to be identified, but they point to a lower propensity for use. As regards the political response to

6. This difference is down to a number of factors, including in particular the fact that the assessment does not take account of informal care and that institutional care costs include accommodation.

7. Diepstraten et al. *(2020) show that people who have adapted their homes to make them more accessible have a lower risk of living in an institution.*

8. See https://drees.shinyapps.io/Barometre-DREES/.

the LTC needs, this may question the impacts of encouraging people to remain in their own homes while not making any significant changes to the number of beds available, as mentioned in the introduction.

In the absence of precise data on these factors and the changes thereto, models aiming to predict the use of institutional care often take account of only a small number of factors – as was the case for the first exercises, such as the one performed by Dick *et al.* (1994) using age, gender and ethno-racial characteristics. Kemper & Murtaugh (1991), for the United States, took their forecast a step further by using more information on the people concerned. However, their model was based on data from a cohort of people aged 65, limiting the scope of the results. In France, the *Lieux de vie et autonomie* [Accommodation and autonomy (LIVIA)] model by Miron de l'Espinay & Roy (2020), uses age, gender and disability. Outside of these three factors, the model therefore assumes that the dynamics of the rate of people living in institutions are solely dependent on changes in the number of people to be accommodated.

2. Data and Methods

In order to explore the factors behind the recent change in the rate of people living in institutions, we make use of data from two major surveys conducted seven years apart in France. We present these data here, together with the study variables, and then the analysis framework and our approach.

2.1. Data and Variables

2.1.1. The Handicap-Santé (2008-2009) and CARE (2015-2016) surveys

The use of EHPA is studied here on the basis of data from the *Handicap-Santé* and *Capacités et Aides et REssources des seniors* (CARE) surveys conducted by the Directorate of Research, Studies, Evaluation and Statistics (DREES) of the French Ministry of Health and Social Affairs. These two surveys are based on similar survey design, and provide comparable information on the main individual and family factors for using insitutional care (Box 1). Their similarity makes it possible to observe the dynamic change in the use of institutional care over a span of seven

Box 1 – **The *Handicap-Santé* (2008-2009) and *Capacités, Aides et REssources des seniors* (CARE) (2015-2016) surveys**

The *Handicap-Santé* [Health and Disability] (2008-2009) and CARE (2015-2016) surveys were conducted by DREES with the primary objective of estimating the prevalence of activity limitations in France, the various dimensions of people's living conditions, as well as the nature, quantity and origin of care received. Each of the two surveys covers the population living in ordinary housing (households) and in institutions.

The samples for the household components (*Handicap-Santé Ménages* – HSM, 2008; *CARE-Ménages* – CARE-M, 2015) are made up of respondents to the *Vie Quotidienne et Santé* [Everyday Life and Health] survey (conducted in 2007 and 2014, respectively). This makes it possible to identify persons with disabilities and to over-represent them in the household components. The samples for the "institutional care" components (*Handicap Santé Institutions* – HSI, 2009; *CARE-Institutions* – CARE-I, 2016) are drawn in two stages: first care facilities and then residents. The selected institutions are EHPAD, non-EHPAD nursing homes and long-term care units (USLD). *Handicap-Santé Institutions* also includes care facilities for disabled adults, psychiatric units and accommodation and social rehabilitation centres (CHRS). We have kept these care facilities within the analysis, even though they are not specifically intended to accommodate old people with disabilities, since they only represent a very small proportion of persons aged 75 and over. The response rates are shown below.

Response rate of persons aged 60 and over within the sources used

	Pre-survey (%)	Survey (%)
HSM 2008	58 (VQS 2007)	73
HSI 2009	97 (care facilities)	93 on EHPAD, EHPA and USLD
CARE-M 2015	57 (VQS 2014)	71
CARE-I 2016	89 (care facilities)	85

The two surveys include a large number of questions that are identical in both the ordinary housing and institutional care components. These surveys are conducted face-to-face. The persons having difficulty in responding to surveys may have received help from a family member or health professional. The response bias associated with this use of a proxy does not appear to affect the declared needs of the individual (Davin *et al.*, 2009). Some of the missing values linked to partial non-response were imputed using the hot-deck method (Andridge & Little, 2010).

Our final base includes 15,944 individuals aged 75 and over living in metropolitan France, 7,073 for 2008 (2,918 living in institutions) and 8,871 for 2015 (2,930 living in institutions).

years. These are the only representative data of the old population living in ordinary housing and in institutions combining health and socio-demographic variables.

The adequate size of the samples make it possible to perform multivariate analyses on the oldest people (those aged 75 and over), since the use of institutional care is rare before this age. We conduct our analysis on samples of 7,073 individuals aged 75 and over residing in France (except overseas territories) in 2008 and 8,871 in 2015. The data are pooled to analyse in-home care and institutional care on both dates (2008 and 2015).

2.1.2 Variables

The use of EHPA, which is our variable of interest, is measured via the probability of living in an institution rather than in ordinary housing in the pooled sample. A person is considered to be living in an EHPA if they are included in the HSI or CARE-I sample, and they are considered to be living in their own home if they are included in the HSM or CARE-M sample. The rate of people living in institutions is the proportion of people living in EHPA. We use the survey weightings to calculate this.

Based on the literature, we retain the following key explanatory variables:

- Age is broken down into three classes: 75-79, 80-89 and 90+. The change in the structure of the age groups is linked to the dynamics associated with smaller or larger generations reaching the various ages. A large number of people reaching the old age group would temporarily lower the average age of the old population, subsequently increasing it if the next generation is smaller.

- Functional health is measured based on the functional limitation (FL) and activity restriction (AR) indicators. FL include both physical and cognitive limitations. They are captured by questions concerning the degree of difficulty people have in walking, climbing stairs, raising their arms, using their fingers, kneeling or carrying loads, remembering the time of day, concentrating, solving everyday problems, and whether they have memory gaps. The AR indicator concentrates on basic daily activities (difficulties with personal hygiene, dressing, eating, cutting up food, using the toilet, lying down, and sitting); resulting in need for care; difficulties in such activities are used in the majority of studies to reflect situations involving dependency on someone's help. We only take account of severe activity limitations (major difficulty or impossibility of completing activities alone). We establish a disability level variable reflecting how advanced in the disablement process a person is (Verbrugge & Jette, 1994) with three modalities: Autonomy (no severe FL or AR); FL only (at least one FL but no severe AR); FL and AR (at least one severe AR).

- The socio-economic status is approached by the highest level of education attained, broken down into three modalities: low (no certificate or diploma of primary education and leaving certificate); intermediate (certificate of professional competence, diploma of occupational studies or baccalaureate); high (higher education qualification). Additional analyses, not presented here, include the former socio-professional category, but the estimates lose in significance due to the strong correlation with the level of education.

- The family configuration is used here with a view to reflecting the informal care resources that could potentially be called upon to enable in-home care provision by informal caregivers. This is a measure of potential care and not actual care. We consider the fact of a living partner, child or sibling.

Table 1 describes the samples in 2008 and 2015 (weighted data) according to these various characteristics.

The use of EHPA by persons aged 75 and over increased from 8.4% to 9.2% between 2008 and 2015, which is a significant increase of 0.8 percentage points (pp), relatively close to the figure obtained using other data sources.[9]

The proportion of men has increased due to the increase in their life expectancy; this contributes to the increasing probability of living with a partner (+4.6 pp). People were also more likely to have children in 2015 (+3 pp). The educational level of persons aged 75 and over continues to improve following its trend from the 20th century. In terms of functional status, an increase is observed in the proportion of people without disabilities, but also in that of persons reporting severe activity limitations, undoubtedly driven by the increase in persons aged over 90.

9. Using the DREES surveys on institutions for the old population, the number of EHPA residents (France, excluding Mayotte) in the population aged 75, we estimate the rate of people living in institutions at 8.6% in 2007 and 9.2% in 2015. Based on the broader scope of the census data (number of people living in collective residences), we estimate the rate of people living in institutions at 9.3% in 2008 and 9.7% in 2015.

Table 1 – **Distribution of individual and family characteristics in 2008 and 2015**

		2008 (%) (1)	2015 (%) (2)	Change (pp) (2)−(1)
% of people living in institutional care		8.4	9.2	+0.8**
Age	75-79 years	40.9	36.0	−4.9***
	80-89 years	51.1	49.8	−1.4*
	90 years or over	7.9	14.3	+6.3***
Gender	Women	63.1	61.4	−1.7**
	Men	36.9	38.6	+1.7**
Level of disability	Autonomy	22.7	23.4	+0.6(ns)
	FL only	59.4	57.4	−2.0**
	FL and AR	17.8	19.2	+1.4**
Level of education	Low	77.7	67.2	−10.4***
	Intermediate	15.7	24.4	+8.7***
	Higher	6.6	8.4	+1.7***
Marital status	Single	54.9	50.3	−4.6***
	Living with a partner	45.1	49.7	+4.6***
Children	None	15.3	12.3	−3.0***
	At least one	84.7	87.7	+3.0***
Siblings	None	39.4	35.6	−3.8***
	At least one	60.6	64.4	+3.8***

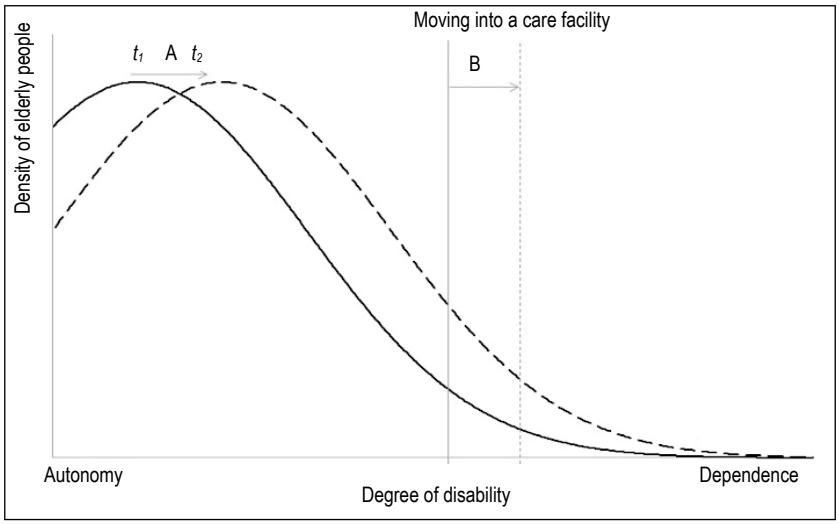
Notes: FL: functional limitations; AR: activity restrictions; pp: percentage point.
Reading note: In 2008, 8.4% of people aged 75 or over living in metropolitan France live in an institution, compared with 9.2% in 2015.
Sources and coverage: DREES surveys: HSM 2008, HSI 2009, CARE-Ménages 2015 and CARE-Institutions 2016. Individuals aged 75 and over living in metropolitan France in 2008 and 2015 (at home and in institutions).

2.2. Analysis Strategy

In this research, we analyse pooled data from both surveys with a view to using logistic models to estimate changes in the use of institutional care and the associated dynamics. We draw upon the framework proposed by Meijer *et al.* (2015), according to which the demand for care changes in line with the number of old people, disability and the behaviour of individuals.

This can be illustrated by Figure I, which represents the proportion of people aged 75 and over classified according to their degree of disability on dates t_1 and t_2. The area under each of the curves is an approximation of the demand for care. As the population ages, the number of old people is expected to increase, as is the average level of disability. This assumption causes the density function to shift to the right (Arrow A). Assuming the existence of a degree of disability after which people are taken into care within an institution (vertical line), it is possible to divide the elderly population into two sub-populations: those living at home (to

Figure I – **Degree of disability and probability of living in institutions**



Notes: The solid curve represents the distribution of persons aged 75 and over according to the degree of disability at date t_1. The dotted curve represents that distribution at date t_2.
Sources: Adapted from de Meijer *et al.* (2015).

the left of the vertical line) and those living in an institution (to the right of the vertical line). A change in the behaviour of individuals, linked to a change in their preferences or in the beds available, can affect the threshold at which people move into institutional care (Arrow B). The increase in limitations and the fact that the threshold for moving into an institution is also increasing may eventually cancel one another out, leading to a stable proportion of old people living in institutions.

We start by modelling the probability of living in institutions based on the considered factors in order to deduce their level of association and then the change in use between 2008 and 2015, all else being equal. We then decompose the difference in the rate of people living in institutions between 2008 and 2015 in order to identify which elements of the difference can be attributed to a change in the frequency of factors within the population – for example, a change in the proportion of persons with the highest level of education or the presence of relatives (composition effect) – or to a change in the link between these factors and the use of institutional care – for example, a change in the link between the level of disability and the use of institutional care (behaviour/preference effect).

3. Analyses and Results

3.1. The Impact of Characteristics on the Use of Institutional Care

The impacts of characteristics (marginal effects) are estimated by estimating a simple Logit model for the sample containing the observations from 2008 and 2015. The change in the rate of people living in institutions during this period is measured by a *year* indicator, which is the only variable factor in Model 0, and then by integrating the individual and family characteristics in Model 1. Model 1 assumes that the impact of these characteristics on the probability of living in an institution remained unchanged between 2008 and 2015, an assumption that will subsequently be tested with a decomposition. The results are presented in Table 2.

As expected, the age and level of disability are positively correlated with the probability of living in an institution. ALs increase the probability of living in an institution by 0.21 percentage points (pp), all else being equal. As regards the impact of gender, women were on average, in both 2008 and 2015, more likely to move into an institution than men. However, this difference is not significant in the adjusted model. The level of education is also positively correlated

Table 2 – **Marginal effects from the logistic regression of the probability of living in a care facility**

	Model 0		Model 1	
	Marginal effect	*SE.*	Marginal effect	*SE.*
Year (*Ref.* 2008)				
2015	0.008**	*0.004*	−0.001(ns)	*0.001*
Age (*Ref.* 75-79 years)				
80-89 years			0.017***	*0.002*
90 years or over			0.040***	*0.004*
Gender (*Ref.* Men)				
Women			−0.002(ns)	*0.002*
Level of education (*Ref.* Intermediate)				
Low			−0.001(ns)	*0.002*
Higher			0.005(ns)	*0.004*
Marital status (*Ref.* Not living with a partner)				
Living with a partner			−0.039***	*0.002*
Level of disability (*Ref.* Autonomy)				
FL only			0.014***	*0.001*
FL and AR			0.211***	*0.008*
Children (*Ref.* None)				
Yes			−0.027***	*0.003*
Siblings (*Ref.* None)				
Yes			−0.002(ns)	0.002

Notes: FL: functional limitations; AR: activity restrictions; SE.: standard error.
Reading note: Being aged between 80 and 89 years increases the probability of living in an institution by 0.02 percentage points relative to being aged between 75 and 79 years, all else being equal.
Sources and coverage: DREES surveys: HSM 2008, HSI 2009, CARE-Ménages 2015 and CARE-Institutions 2016. Individuals aged 75 and over living in metropolitan France in 2008 and 2015 (at home and in an institution).

with the probability of living in an institution, albeit not significant. There is a significant link with marital and family situations: living with a partner or having children reduces the probability of living in an institution. No significant link is observed with having siblings.

With the characteristics introduced in Model 1, there is no significant difference in the probability of living in institutions in 2008 or 2015. This result suggests that the increase in the rate of EHPA use observed during the period (+0.8 pp) can be largely explained by the change in the characteristics of the elderly population (see Table 1). According to this first result, the change in the use of institutional care does not reflect an overall change in behaviour with regard to the use of institutional care. A decomposition of the change will allow us to look further into this point.

3.2. Decomposition of the Change in Use of Institutional Care

Decomposition methods generally aim to distinguish between the part of a difference observed between two groups of individuals (for example, in their income) that can be explained by differences in characteristics (composition effect) and the part that remains unexplained by such differences in characteristics (interpreted as the difference in the association between income and the characteristics under consideration). We rely here on the decomposition methods developed by Fairlie (2005) and Yun (2004) for dichotomous dependent variables (see Appendix 1).

Our methodological approach has three objectives. The first is to estimate how much of the change in the use of institutional care between 2008 and 2015 can be explained by changes in the spread of socio-demographic factors (aggregate composition effect). More specifically, this amounts to estimating a counterfactual corresponding to the rate of institutional care use that would have been observed in 2015 had the composition been the same as in 2008: the parameters linking the characteristics to care facility use, estimated in 2015 with a logistic model, are applied to the 2008 population to obtain the predicted counterfactual probability for 2015. We then obtain a counterfactual change between 2008 and 2015, which is compared with the observed change: the difference is the part of the change that can be explained by changes in composition.

Based on this analysis, we deduce the part that cannot be explained by the composition effect, which is in part attributable to changes in the parameters linking the factors to the use of institutional care. This can also be evaluated by means of a counterfactual: this time, the predicted probability of using institutional care in 2015 is calculated by applying the 2008 parameters to the 2015 composition. The difference between the counterfactual and the observed changes corresponds to the part associated with changes in the links between the characteristics (age, gender, level of disability, family configuration, level of education) and the propensity to live in institutions. The part of the change that cannot be explained is therefore interpreted as the impact of a change in the behaviour of old people (or that of their potential caregivers), a change in preference for care or a change in context (change in the number of beds available in medical and social services, a change in prices or a change in public policy). Although it is not possible, based on the data being used, to explore the precise drivers of changes in the link between the observable characteristics and the behaviours associated with living in an institution, an estimation of this unexplained part of the change provides new information. It allows assessing the assumption generally made in the projection of rates of people living in institutions, namely the stability of the use of institutional care for the given socio-demographic characteristics.

The explained and unexplained components can then be decomposed to estimate the contributions of each factor: it is assumed, for example, that in the explained component, the increase in the proportion of persons aged over 90 and those reporting activity restrictions or even those with the highest levels of education, which are all factors that are positively correlated with the use of institutional care, has tended to increase the probability of living in an institution; conversely, changes in family structure should tend to reduce it. This step should allow identifying whether the existing projections of the number of old people living in institutions, based on the projections of the number of old people by age and level of disability, would benefit from the consideration of changes in other characteristics.

3.3. Composition Effects and Change in Practices?

The aggregate decomposition makes it possible to estimate firstly the rate of use that would have been observed in 2015 had the composition of the population in terms of age, gender, level of education, degree of disability and family structure remained the same as in 2008. The increase in the use of EHPA would, in this case, have been more pronounced (+1.1 pp estimated compared with +0.8 pp observed) than what is actually observed (Table 3). The decomposition performed

Table 3 – **Aggregate decomposition of the change in the rate of use of institutional care (reference 2008)**

	Total (*N*=15,944)	Women (*N*=11,138)	Men (*N*=4,806)
Rate of EHPA use in 2008 (%)	8.4	10.3	5.3
Rate of EHPA use in 2015 (%)	9.2	11.6	5.4
Increase observed (pp)	+0.8**	+1.3***	+0.1(ns)
*Variation explained by the change in composition (*ref. *2008) (pp)*	*+1.1***	*+1.9***	*−0.1(ns)*
Variation not explained by the composition (pp)	*−0.3(ns)*	*−0.6(ns)*	*+0.2(ns)*

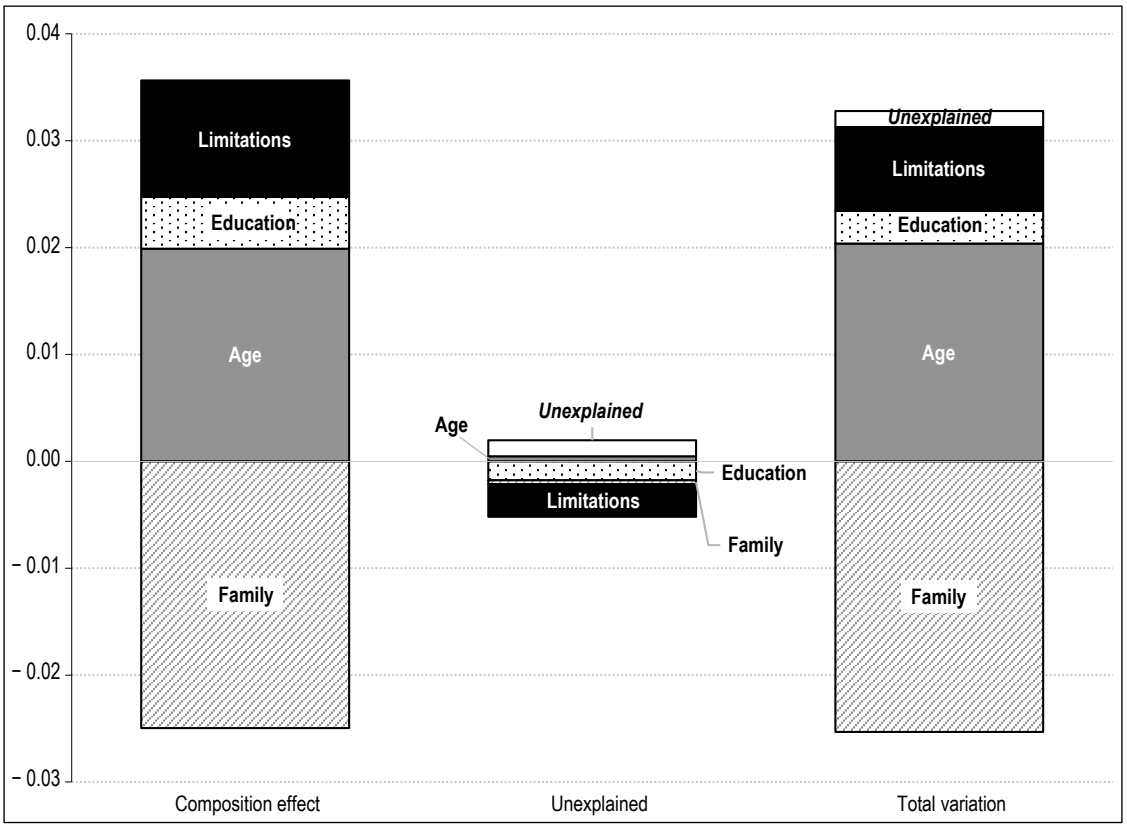
Notes: Significance thresholds ** at 5%, *** at 1%.
Reading note: The rate of use of EHPA increased by 0.8 pp between 2008 and 2015 with composition changes increasing that rate of use by 1.1 pp.
Sources and coverage: DREES surveys: HSM 2008, HSI 2009, CARE-Ménages 2015 and CARE-Institutions 2016. Individuals aged 75 and over living in metropolitan France in 2008 and 2015 (at home and in institutions).

separately for women and men reveals that the composition effect affects women in particular.

These results therefore confirm the composition effect, which was hinted at by the simple logistic analyses; an unexplained component may also have contributed to limiting the change, but not significantly.

The detailed decomposition reveals the contribution of the various factors to the composition effect – illustrating those that had a tendency to increase the use of institutional care and those that had a tendency to decrease such use – and to the difference that cannot be explained by the change in factors – illustrating the change in their link to the use of institutional care. One constant remains unexplained by composition effects or a change in the link between factors and the use of institutional care. The results are summarised in Figure II, i.e. as a summary of the impacts of the factor modalities (the detailed results are provided in Appendix 2).

Figure II – **Decomposition of the change in the use of institutional care between 2008 and 2015**



Notes: Decomposition with 2015 parameters as reference; representation of the total contributions of the education, family (presence of a partner; at least one child; a sibling), disability, gender and age variables.
Reading note: Disabilities contributed positively to the increase in use of EHPA (total effect) due to the positive contribution to the composition effect (due to the increase in the prevalence of activity limitations between 2008 and 2015) and the negative, but lesser, contribution to the unexplained effect (due to a – non-significant – decrease in the link between disability and the use of institutional care).
Sources and coverage: DREES surveys: HSM 2008, HSI 2009, CARE-Ménages 2015 and CARE-Institutions 2016. Individuals aged 75 and over living in metropolitan France in 2008 and 2015 (at home and in institutions).

This detailed decomposition confirms that demographic ageing (change in composition according to age groups) is the primary factor tending to increase the rate of institutional care use over this period with, all else being equal, an increase of +2 pp (with the increase in the share of persons over 90 making the most of the contribution). Changes in the level of disability (and in particular in the prevalence of ARs) and in levels of education reinforce this trend towards a greater use of institutional care (+1.1 pp and +0.5 pp respectively). Conversely, changes in the family structures of old people balance out these trends by introducing a reduction in the rate of people living in institutions between 2008 and 2015 (−2.5 pp). This effect is largely down to an increase in the number of people living with partners (−1.6 pp), followed by an increase in the number of people with at least one child (−0.7 pp). The reduction in the number of old people without siblings also contributes to this (−0.2 pp), but not significantly. This overall change in the structure of families more than offsets the impact of demographic ageing, a sign that the changes in the density of the family entourage are a key factor in anticipating the number of beds that will be required in institutions in the future.

The unexplained part (which reflects changes in the link between the factors and the use of care facilities) is much smaller, not significant, and positive and negative changes offset each other. However, it is interesting to note that the change in degrees of disability tends to go hand in hand with lower use of institutional care, which can be interpreted as a change towards types of disability that can be more easily managed at home: either because they are less complex or because the support systems allow for better care to be provided at home than previously. It is also possible that institutions are more selective.

4. Discussion

4.1. Synthesising the Results

Our results reveal that the relatively limited increase in the proportion of persons aged 75 and over living in institutions is more related to composition effects than to a greater propensity to remain in their own homes. Indeed, some of the factors positively correlated with moving to institutions (ageing, activity limitations) are more frequently encountered in 2015 than in 2008 and contributed to increasing the overall use of institutional care, while others, which are also more frequent in 2015 (more men, more people living with a partner and more people with children), which are negatively correlated with the use of institutional care, reduced this. These effects are driven by the female population in particular. Although women are less inclined than men to use care facilities, they are more likely, all else being equal, to do so due to their greater longevity and greater exposure to disabilities. However, during the period in question, women were able to grow old with more people around them, in particular their partner, giving them greater family support to remain in their own homes. We also observe that, although not significant, their dominance in terms of numbers in institutions has reduced slightly, while the proportion of men aged 75 and over has increased. Conversely, although the association is not significant, it can be seen that the link between disability and the use of institutional care is becoming weaker: this could reflect an increase in the eligibility threshold for institutional care as a result of fewer beds being available, or the fact that the nature of any activity limitations has moved towards forms that can be more easily managed at home by relatives and through the adaptation of services. In fact, there are signs of a decrease in the proportion of people experiencing activity limitations related to cognitive disorders in France and elsewhere, which could partly explain this result (Bonnet *et al.*, 2021).

Overall, the part of the change that cannot be explained by the composition effect is small and not significant. This suggests that, all else being equal, behaviours with regard to the use of institutional care have remained stable over the period. Therefore, unlike the results from the Netherlands (de Meijer *et al.*, 2011; Alders *et al.*, 2017), the limited increase in the use of institutional care in France does not appear to be explained by the fact of encouraging people to remain in their own homes and by a change in the in-home vs institutional LTC system, especially since it has not resulted in increased access to care services. In the Netherlands, individual choice appears to be more limited and more dependent on whether or not the general population and the authorities want to keep old people at home for longer.[10] However, a real shift in the direction of remaining at home has occurred: the number of beds in institutions has been reduced, compounding the lack of available space; in-home care has increased, helping people to remain in their own homes. In France, that shift towards in-home care has not really materialised. It is therefore not surprising that

10. In the Netherlands, an independent agency assesses individual requirements and prescribes a care package.

there was no substantial change in the propensity to move into an institution and that the limited increase in the proportion of old people living in institutions can be explained by the fact that they are more likely to be surrounded by family, particularly in the case of women. This result, if confirmed over time, would point to a transfer of care to family caregivers, whether facilitated by a range of available services and less complex functional limitations that would allow families to keep their relatives at home, or made necessary by a lack of available beds within institutions.

4.2. Limits

In this article, we compared the use of institutional care and in-home care in 2008 and 2015, based on the fact of living in institution or at home; however, we did not take account of the possible trade-offs between formal homecare and within an institution. This analysis will therefore need to be continued in order to identify whether the low level of use of institutional care by certain segments of the population has been accompanied by increased use of formal homecare. Our data do not allow us to take account of the change in care and public policies aimed at people experiencing a disability, nor to identify whether changes in behaviour with regard to the use of institutional care are due to the wishes of old people or whether they are imposed due to a lack of available beds, the cost of these institutions. It appears that the use of institutional care has changed little (Muller, 2017b), as is also the case for in-home care (Carrère *et al.*, 2021). However, the availability of beds appears to be a decisive factor favouring or preventing the use of institutional care (Theisen, 2017; Charles & Sevak, 2005; Jette *et al.*, 1995; Carrère, 2021). In addition, the costs of formal care within an institution have increased: according to Muller (2017b), the daily rate for accommodation increased by EUR 4.30 between 2011 and 2015. The increase is also notable for formal home care: the hourly rates of home-based employees paid by individual employers in receipt of the *Allocation personnalisée d'autonomie* (personal autonomy allowance, APA) increased by 17% between 2008 and 2015, which is more than the reference hourly rate that departments use to calculate the share of the hourly rate financed by the APA.

The fact that the price of in-home care affects the demand for care has been demonstrated in France (Bourreau-Dubois *et al.*, 2014; Hégé, 2016; Roquebert & Tenand, 2017). Roquebert & Tenand (2017), for example, reveal that an increase of 10% the hourly rate that is still to be paid for formal care received reduces the number of hours of care received by between 2 and 6%. The results are less clear for institutional care. However, there appears to be some substitution between the various types of care based on differences in cost between in-home care and institutional care (Carrère & Jusot, 2020). These elements suggest that taking account of changes in relative costs, or in availability, could partly account for the unexplained part of the change in the rate of people living in institutions.

Finally, the available data do not allow us to precisely measure the factors taken into account in this study: on the one hand, the family environment, as measured here, does not reflect the availability and willingness of relatives to provide care, but only whether the person in question has relatives or no; on the other hand, the socio-economic status measured by level of education offers a poor reflection of the standard of living and the ability to bear the cost of care. We also do not have any information with regard to wealth.

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Against a backdrop of an increasing old population coupled with few beds being implemented within institutions, it is difficult to unravel the reasons behind the modest increase in the proportion of elderly people living in institutions. Data from the HSM 2008 and HSI 2009, CARE-Ménages 2015 and CARE-Institutions 2016 surveys were used to analyse previous changes in the use of institutional care and to understand the dynamics of those changes, whether they be linked to a change in the composition of the population or a change in behaviour with regard to the use of institutional care.

In spite of the limitations outlined above, it seems that the practices of using institutions associated with the different factors changed little over the period studied and that there is no sign of a decrease in the propensity to make use of institutions. If the configuration of the beds available remains unchanged in the coming years, this result would support the assumptions of stability of these parameters made in the projection models used to forecast the number of institutions and in-home care that will need to be implemented in the coming years (Miron de l'Espinay & Roy, 2020).

However, our results do show the significant impact of the presence of family members,

which is not taken into account the majority of models and which reduces the use of institutional care: this is a key factor in controlling the use of institutional care, particularly for women. This result calls into question the shift towards in-home care and its longer-term consequences. Indeed, it appears that the availability of potential caregivers has been the most important factor in offsetting the ageing of the old population and the increase in certain types of disability. The shift towards in-home care therefore appears to be based on informal care, which may give rise to questions concerning the sustainability of this situation.

Furthermore, recommendations could be made that the projection models take greater account of this family factor. However, as we have already highlighted, the presence of relatives does not necessarily mean that they will act as caregivers. The preferences of people needing assistance with regard to reliance on their relatives may change as new generations reach old age, particularly with the greater frequency of family reconfigurations, divorces at older ages and the geographical distances between family members (Bonnet *et al.*, 2021). These trends may change the links between the presence of relatives and remaining at home in the future. More people could decide to seek professional care, even where their family members are more present.

In addition, our results about the impact of gender (and disabilities among women) lead us to question whether women are given the opportunity to manage their disabilities at home. Although they are more likely to grow old with a partner than before, women are still more likely to be widowed and less likely to find a new partner than men if they are separated. They are just as likely, if not more so, to be forced to move into an institution when they grow old. While we consider women to be better able to continue living without assistance for basic housework in their own homes, we should also question the role of constraints, such as a lack of available beds in institutions or difficulties in covering costs that increase their risk of not being able to receive care in EHPA.

Care provision must therefore be developed to respond to the needs of a changing old population. While the role of family has strongly contributed to people remaining in their own homes, questions must be asked with regard to the sustainability of this solution. The aim would be to offer a professional care service at home and in institutions that could be adapted to the needs of people who will not have the option of remaining in their own homes due to their disabilities, by choice or due to an absence of family caregivers. □

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APPENDIX 1

DECOMPOSITION METHOD

Decomposition methods were initially developed to highlight gender-based wage discrimination phenomena on the labour market in the United States (Oaxaca, 1973) or those between white and black workers (Blinder, 1973). Fairlie (2005) transposes the Oaxaca-Blinder canonical model to dichotomous dependent variables (whether or not an individual is living in an institution in our case).

Here, we provide a summary of the formal analytical framework of the Fairlie model. We have based this summary on Boutchenik *et al*. (2019), adapting notations to our study. E_{2008} is the sample of individuals observed in 2008 and E_{2015} is the sample of individuals observed in 2015. $\overline{Y}_t$ (for t = 2008,2015) denotes the rate of people living in institutions:

$$\overline{Y}_{2008} = \frac{1}{N_{2008}} \cdot \sum_{i \in E_{2008}} Y_{i,2008} \text{ and } \overline{Y}_{2015} = \frac{1}{N_{2015}} \cdot \sum_{i \in E_{2015}} Y_{i,2015}$$

where N_t is the size of the sample in t and $Y_{i,t}$ is a dichotomous variable equal to 1 if individual i was living in an institution in t, or 0 if not.

In order to decompose the difference in the rates of people living in institutions between 2008 and 2015, we start by estimating the individual probability of living in an institution at each of the two dates using a simple Logit model:

$$P_{2008}\left(Y_i = 1 | X_i\right) = F\left(X_i \beta_{2008}\right), \forall i \in E_{2008} \text{ and } P_{2015}\left(Y_i = 1 | X_i\right) = F\left(X_i \beta_{2015}\right), \forall i \in E_{2015}$$

where X_i represents the characteristics of individual i, $\left(\beta_{2008}, \beta_{2015}\right)$ are the parameters to be estimated and $F(.)$ the distribution function.

The results of the estimation are then used to predict the rate of people living in institutions that would have been observed in 2015 had the characteristics of the population remained unchanged from those of 2008. In order to do so, we calculate the probability that each individual from 2008 would be living in an institution under the assumption that their individual characteristics would be linked to the probability of living in an institution in the same way as in 2015:

$$\hat{P}_{2015}\left(Y_i = 1 | X_i\right) = F\left(X_i \hat{\beta}_{2015}\right), \forall i \in E_{2008}$$

The expected rate of people living in institutions in 2015 if the characteristics of the population remain identical to those in 2008 is then equal to the average of these predicted probabilities:

$$\frac{1}{N_{2008}} \cdot \sum_{i \in E_{2008}} F\left(X_i \hat{\beta}_{2015}\right)$$

The difference in the rate of people living in institutions $\left(\overline{Y}_{2015} - \overline{Y}_{2008}\right)$ can then be rewritten as follows:

$$\overline{Y}_{2015} - \overline{Y}_{2008} = \underbrace{\left(\frac{1}{N_{2015}} \cdot \sum_{i \in E_{2015}} Y_{i,2015}\right) - \left(\frac{1}{N_{2008}} \cdot \sum_{i \in E_{2008}} F\left(X_i \hat{\beta}_{2015}\right)\right)}_{\text{Composition effect (or explained component)}} + \underbrace{\left(\frac{1}{N_{2008}} \cdot \sum_{i \in E_{2008}} F\left(X_i \hat{\beta}_{2015}\right)\right) - \left(\frac{1}{N_{2008}} \cdot \sum_{i \in E_{2008}} Y_{i,2008}\right)}_{\text{Unexplained component}}$$

The composition effect is the difference between the rates of people living in institutions in 2008 and 2015 that can be explained by the differences in the characteristics of the population observed on the two dates. The unexplained component corresponds to the difference in the average probabilities between 2008 and 2015 that cannot be explained by the (observable) difference in the composition of the population. It reflects a different relationship in 2008 and 2015 between the individual characteristics observed and the probability of living in an institution, together with a residual. This component is based on the difference between $\hat{\beta}_{2008}$ and $\hat{\beta}_{2015}$, and is generally referred to as a difference in "valuation" of the characteristics observed. In this case, for example, an improvement in homecare for people with moderate disabilities could bring about a lower propensity for living in an institution in 2015 than in 2008.

One of the main interests of the Oaxaca-Blinder model lies in allowing the composition effect to be further decomposed in a relatively simple manner to estimate the respective role of each individual characteristic X_k in the difference observed. This is less obvious in the case of a dichotomous variable.

In order to illustrate this difficulty, let us suppose that just two variables are behind the change in the rate of people living in institutions: age and level of disability. In this case, the detailed decomposition aims to evaluate the respective weights of the change in the structure of the population by age and the change in the level of disability with regard to the change in the rate of people living in institutions. In order to do so, a sequential procedure may be implemented, for example. We start by predicting the rate of people living in institutions that would have been observed in 2015 had the age structure of the population been the same in 2015 as in 2008. To estimate the age-related composition effect, we then compare this rate with the rate of people living in an institution actually observed in 2015. In order to estimate the composition effect linked to the level of disability, this same rate is compared with that of people living in institutions that would have been observed in 2015 had the structure of the population by both age and level of disability in 2015 been the same as in 2008. We use a non-linear framework to show that the results of a decomposition of this type are influenced by the order in which it is carried out (Yun, 2004): the estimation of the specific contribution of each characteristic will differ depending on whether we estimate the impact of age followed by that of disability or vice versa. Of the strategies suggested in the literature to overcome this difficulty, we adopt that put forward by Yun (2004), which allows avoiding that the decomposition is not influenced by the order in which the variables are introduced. The method is based on the assignment of a weighting W_k to each variable X_k, reflecting the relative contribution of the difference in the distribution of that variable between the two groups to the difference observed in the variable of interest:

$$W_k = \frac{\left(\hat{\beta}_{k,2015}\left(\overline{X}_{k,2015} - \overline{X}_{k,2008}\right)\right)}{\left(\sum_k \hat{\beta}_{k,2015}\left(\overline{X}_{k,2015} - \overline{X}_{k,2008}\right)\right)}.$$

APPENDIX 2

AGGREGATED AND DETAILED DECOMPOSITION OF THE CHANGE IN THE USE OF INSTITUTIONAL CARE BETWEEN 2008 AND 2015 (2008 REFERENCE COEFFICIENTS)

		Coefficient	P>z	[95% Conf. Interval]
Aggregate decomposition				
Observed variation (total effect)		0.008	0.025	[0.001;0.015]
Effect of the change in composition (explained)		0.011	0.000	[0.009;0.013]
Effect not explained by the composition (unexplained)		−0.003	0.372	[−0.009;0.004]
Detailed decomposition:				
1 – Contribution of changes in the composition of the population to the change in use by factor				
Age	70-79 (decrease)	+0.010	0.004	[0.003;0.016]
	80-89 (decrease)	+0.000	0.205	[−0.001;0.000]
	90+ (increase)	+0.011	0.003	[0.004;0.018]
Gender	Men (increase)	0.000	0.931	[−0.001;0.001]
	Women (decrease)	0.000	0.931	[−0.001;0.001]
Education	Little or no education (decrease)	+0.005	0.002	[0.002;0.008]
	Secondary level education (increase)	−0.001	0.607	[−0.007;0.004]
	Higher education (increase)	+0.001	0.119	[0.000;0.003]
Family	Not living with a partner (decrease)	−0.008	0.016	[−0.015;−0.002]
	Living with a partner (increase)	−0.008	0.016	[−0.015;−0.002]
	No children (decrease)	−0.003	0.028	[−0.007;0.000]
	Children (increase)	−0.003	0.028	[−0.007;0.000]
	Siblings (increase)	−0.001	0.280	[−0.002;0.001]
	No siblings (decrease)	−0.001	0.280	[−0.002;0.001]
Degree of disability	Autonomy (increase)	−0.003	0.017	[−0.005;−0.001]
	FL without AL (decrease)	0.004	0.015	[0.001;0.008]
	FL and AL (increase)	0.009	0.014	[0.002;0.017]
2 – Part of the change explained by a change in the coefficients of the link between factors and use				
Age	70-79	0.000	0.576	[−0.001;0.002]
	80-89	0.000	0.786	[−0.001;0.001]
	90+	0.000	0.507	[0.000;0.000]
Gender	Men	0.000	0.538	[−0.001;0.001]
	Women	+0.001	0.538	[−0.001;0.002]
Education	Little or no education	−0.002	0.401	[−0.006;0.003]
	Secondary-level education	0.000	0.874	[−0.001;0.001]
	Higher education	0.000	0.455	[0.000;0.001]
Family	Not living with a partner	−0.002	0.387	[−0.007;0.003]
	Living with a partner	+0.002	0.387	[−0.002;0.006]
	No children	0.000	0.800	[0.000;0.000]
	Children	0.000	0.800	[−0.001;0.002]
	Siblings	0.000	0.489	[−0.002;0.001]
	No siblings	0.000	0.489	[−0.001;0.001]
Degree of disability	Autonomy	0.000	0.827	[−0.001;0.001]
	FL without AR	−0.004	0.347	[−0.014;0.005]
	FL and AR	+0.001	0.302	[−0.001;0.004]
Unexplained		+0.002	0.498	[−0.003;0.006]

Notes: Decomposition using Yun's (2004) method. Standardised weightings are used to take account of the composition of the population according to the place of residence. The estimated coefficients multiplied by 100 are interpreted as a change in the rate of people moving into institutions as percentage points.
Reading note: The decrease in the proportion of persons with "little or no education" between 2008 and 2015 helped to reduce the share of people aged 75 and over living in institutions by 0.5 pp.
Sources and coverage: DREES surveys: HSM 2008, HSI 2009, CARE-Ménages 2015 and CARE-Institutions 2016. Individuals aged 75 and over living in metropolitan France in 2008 and 2015 (at home and in institutions).

The Health-Consumption Effects of Increasing Retirement Age Late in the Game

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Abstract – Using the differentiated increase in retirement age across cohorts introduced by the 2010 French pension reform, we estimate the health-consumption effects of a 4-month increase in retirement age. We focus on individuals who were close to retirement age but had not yet reached statutory retirement age by the time the reform was passed. Using administrative data on individual sick-leave claims and health-care expenses, we show that the probability of having at least one sickness absence increases for all treated groups, while the overall number of sick days remains unchanged, conditional on having a sick leave. Delaying retirement does not increase the probability of seeing a general practitioner, except for men in the younger cohorts. In contrast, it raises the probability of seeing a specialist physician for all individuals, except men in the older cohorts. Delaying retirement also increases the probability of seeing a physiotherapist among women from the older cohorts. Overall, it increases health expenditures, in particular in the lower part of the expenditure distribution.

JEL: I10, J14, J18, J26
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Population ageing is a major challenge for societies and, in particular, for the viability of social protection systems. Over the past decades, most OECD countries have introduced pension reforms aiming at the financial sustainability of their pension system (OECD, 2017). These reforms are typically multidimensional, but they often include an increase in the statutory and/or ordinary retirement age[1] based on the assumption that delaying retirement creates an incentive for older workers to stay in employment. This should mechanically generate an increase in contributions and reduce pension expenditure on the short term, thereby contributing to the financial balance of the pension and, more generally, the social security systems.

However, this virtuous circle could be broken if postponing retirement negatively affects individual health (L'Haridon *et al*., 2018). The literature has extensively studied the effect of moving from employment to retirement on old-age physical, mental and cognitive health, often using statutory retirement ages as an instrument and pension reforms as an exogenous shock to these ages. The results are overall ambiguous. The meta-analysis conducted by Filomena & Picchio (2022) on 275 observations from 85 articles published between 2000 and 2021 shows that 28% of them find positive effects of retirement on health outcomes, while 13% find negative effects, but even more important, almost 60% of the observations do not provide any statistically significant results. Another strand of literature has focused on the effects of delaying retirement on post-retirement health. In their survey, Garrouste & Perdrix (2021) conclude that later retirement has no effect on mortality, decreases healthcare consumption, and has a negative or non-significant impact on self-reported health at old age.

Nevertheless, pension reforms increasing retirement age are also likely to affect *pre-retirement* health outcomes. To the extent that they increase individuals' residual working horizon, they likely affect the expected value of investments in health which may, in turn, modify individual health conditions (Bertoni *et al*., 2018). At the same time, following changes in the retirement rules, individuals may feel that they are forced into a new situation in which they have little control over their retirement decision. Moreover, if the new rules are perceived as unfair and/or affect individuals close to the retirement age, this may lead to severe disappointment (De Grip *et al*., 2012). Both mechanisms may generate an upsurge in stress that may negatively affect both physical and mental health. If the health conditions of employees affected by the reform are modified, this may improve or hamper their ability to work and hence affect the potential savings expected from an increase in retirement ages. This unintended effect of pension reforms has been much less studied in the literature.

This paper investigates the health-consumption effects of a pension reform that raised statutory and ordinary retirement ages in France in 2010, on individuals who were close to retirement age but had not yet reached statutory retirement age by the time the reform was passed. By mid-July 2010, the French government announced that the statutory retirement age (SRA) – respectively the ordinary retirement age (ORA) – would increase by 4 months for all individuals born between July and December 1951, and by four additional months for each cohort born in the following years until 1956. Since SRA and ORA were initially 60 and 65 respectively, the reform eventually raised them to 62 and 67 for individuals born in 1956 and later. We take advantage of this design to provide a first-difference estimate of the impact of a 4-month increase in retirement age on the sickness absences, physicians' and physiotherapists' visits as well as health-care expenditure of individuals who were at most 5.5 years away from statutory retirement age before the reform was passed.

More specifically, we consider two different samples composed of individuals who were closer to and further away from statutory retirement age – at most 2.5 years for the older ones, and between 4.5 and 6.5 years for the younger ones, after the reform. For each of them, we estimate the effect of a 4-month increase in retirement age across individuals born in two adjacent months, so as to net out the potential confounding effect of age on health conditions. In addition, as a placebo experiment, we check that we find no difference in health consumption across individuals born in two adjacent months who face the same retirement age after the reform. To do so, we leverage administrative data on individual non-hospital health-care and sick leave claims, available for all wage and salaried workers employed in the private sector and contract personnel working in the civil service. We consider health consumption over the period ranging from July 15th 2010 – the day after the reform was announced – to

1. The Statutory Retirement Age (SRA) is the earliest age at which retirement benefits can be claimed conditional on a given number of years of contribution to the pension system. The Ordinary Retirement Age (ORA) is the age at which workers are eligible for full old-age pension independent of the number of years they have contributed.

May 31st 2011 – the day before the older cohort started retiring.

Our results suggest that increasing statutory and ordinary retirement ages by four months raises the probability of having at least one sickness absence over the period we study, by 11.8% for men and 10.3% for women in the older cohorts, and by 6.7 and 3.9% for men and women respectively in the younger ones. In contrast, we do not find any effect of the reform on the number of days of sick leave, conditional on having one, when estimating a zero-inflated negative binomial model. As regards physicians' visits, we show that delaying retirement does not increase the probability of seeing a general practitioner (hereafter GP), except for men in the younger cohorts. In contrast, it raises the probability of having at least one visit with a specialist physician for all individuals, except men in the older cohorts,[2] although the effect is moderate (about 1.5%). Moreover, delaying retirement increases the probability of seeing a physiotherapist by 3.4% among women from the older cohorts. Finally, when estimating unconditional quantile regressions for health-care expenditure, we find increases in expense claims consistent with the above findings, in particular in the lower part of the expenditure distribution. The same holds for drug expenditure of men in the younger cohorts. This suggests that expense claims increase when retirement age is raised, in particular among individuals who initially had low levels of health-care expenditure.

We interpret our findings as suggesting that individuals affected by changes in the pension system late in their career experience psychological, and even physical, health troubles, at least over the year following the announcement of the reform.

Our paper speaks to two strands of literature. The first one is quite small and considers the effect of changes in retirement age on pre-retirement health and health behaviour of workers who were late in their career when the reform was passed. Bauer & Eichenberger (2021) examine a policy change that lowered retirement age from 65 to 60 in Switzerland. They show that, while the reform was intended to improve workers' health, it resulted in the opposite outcome. Sickness absences increased by 33% among 56-60-year-old construction workers when working until 60 instead of 65, and the probability that they report health problems increased by 54%. This is, to some extent, in line with Bertoni *et al*. (2018) who find that an increase in minimum retirement age – induced by a pension reform affecting eligibility conditions in Italy in 2004 – improved health behaviours among middle-aged men. A one-year increase in the residual working horizon increased the likelihood of exercising regularly, the probability of having a body mass index below the level indicating obesity and the probability of reporting a high satisfaction with one's own health. In contrast, in their seminal work on the subject, De Grip *et al*. (2012) find that delaying retirement deteriorates mental health. They assess the effect of a change in the Dutch pension system that raised the minimum retirement age by 1 year and 1 month for public-sector workers to be eligible to full-pension benefit. They find that, two years after the policy change, the depression rates were about 40% higher in the treated group than among control individuals. Our results complement De Grip *et al*. (2012) results'. We show that a modest 4-month increase in retirement age substantially increases the probability of sickness absence also among private-sector workers aged 54 and above, in France. This finding is in line with d'Albis *et al*. (2020) who also find that the French 2010 pension reform increased sickness absences among a smaller sample of public-sector high-school teachers. In addition, we show that delaying retirement increases the probability of seeing a specialist physician, and correspondingly raises health expenditure, in particular among workers with low initial health-care expenses.

Our research also complements the literature on the health impact of retirement in France. Using household data, L'Haridon *et al*. (2018) and Messe & Wolff (2019) compare the health trajectories of individuals who retire and those of individuals who stay in employment, after balancing their pre-retirement characteristics. They find that transition into retirement has a short-term beneficial effect on respondents' self-assessed health. Consistent with these findings, Blake & Garrouste (2019) show that the increase in the required number of years of contribution to be eligible to full-pension benefit and the reduction of pension levels, imposed on private-sector employees by the 1993 pension reform, had a negative effect on perceived and physical health of low-educated retirees. Nonetheless, Bozio *et al*. (2021) do not find any significant effect of this reform on mortality rates between ages 61 and 79. We complement this literature by investigating

2. These results are not inconsistent with what we find for GPs since, in France, specialist physicians can be accessed directly, without being referred by a GP.

the effects of a more recent pension reform on individuals who are still in employment at the time of the reform. We show that postponing retirement increases their health consumption, thus suggesting that working longer is not only detrimental at old ages but can have negative health effects on active individuals, at least when introduced late in their career. Finally, Ben Halima *et al*. (2022) estimate the effect of being above or below the statutory retirement age on sickness absences of cohorts affected in a different way by the 2010 pension reform. We improve on their methodology by proposing an empirical set up which allows identifying the causal effect of the reform on sick leaves and health-care expenditure, while being immune to strong assumptions on parallel trends.

The remainder of the paper is organised as follows. Section 1 presents the institutional context. Section 2 develops our empirical strategy. Section 3 describes the data. Section 4 presents the results and we conclude.

1. The Institutional Context

France has a variety of pension and health insurance schemes to which individuals contribute based on their occupation and/or on the sector in which they are employed. In this paper, we consider a pension reform passed in 2010 that increased the statutory and ordinary retirement ages for all salaried workers. However, we restrict our analysis to wage and salaried workers employed in the private sector and contract personnel working in the civil service, since our health data do not cover civil servants nor self-employed workers.

Although the reform was definitely adopted by parliament on October 27th 2010, the need to rebalance the accounts of the French public pension system had been in the public debate since 1993. However, during this period, the option favoured by policy makers had been an increase in the number of years of contribution required to be eligible to full-pension benefit (d'Albis *et al*., 2020). This was actually progressively raised from 37.5 years for cohorts born in 1933 and before, to 40 years for cohorts born in 1944 and later, starting as of 1993 in the private sector and 2003 in the public sector. The number of years of contribution was then further raised to 41 in 2009. The idea of increasing the statutory and ordinary retirement ages came up later in the public debate, in the course of Spring 2010. On May 16th, a Government Policy Paper on pension reform was handed to social partners. It mentioned that the only solution to ensure the financial sustainability of the pension system without affecting the standard of living of retirees and employed workers would be to increase the statutory retirement age. On June 16th, the Minister of Labour, Eric Woerth, presented the main orientations of his pension-reform project: The statutory retirement age would be progressively raised from 60 to 62 – while the ordinary retirement age would be raised from 65 to 67 – and the reform would not affect cohorts born before 1951. On July 13th, the bill was finally presented to the Council of Ministers. It made it clear that statutory and ordinary retirement ages would increase in a differentiated way across cohorts, according to the schedule shown in Table 1.

In this first stage of the reform, the statutory and ordinary retirement ages were therefore increased by four months for the first cohort (born between July and December 1951) and by four additional months for each cohort born in the following years until 1956. For all individuals born in 1956 and later, SRA and ORA increased by 2 years as compared to what they used to be prior to the reform, to 62 and 67 respectively. The reform was then accelerated on January 1st 2012: for cohorts born after January 1st 1952, the increase in the statutory and ordinary retirement ages across cohorts was raised from four to five months until the two age limits reached 62 and 67 respectively, which occurred for individuals born in 1955 and later.

It has to be noted that the 2010 reform did not apply to individuals who had started working before 18 years old: the statutory retirement age remained 60 for those of them who had

Table 1 – **Statutory and ordinary retirement ages by date of birth**

Birth date	Statutory retirement age	Ordinary retirement age
Before July 1951	60	65
From July 1st to December 31st 1951	60 + 4 months	65 + 4 months
1952	60 + 8 months	65 + 8 months
1953	61	66
1954	61 + 4 months	66 + 4 months
1955	61 + 8 months	66 + 8 months
1956 and later	62	67

contributed at least 43.5 years to the pension system. Since 2010, they could even retire at 58 if they had started working before the age of 16.

An important feature of the reform is that who exactly would have been affected and to what extent, among individuals born in 1951 and later, was unknown until July 13th, when the Minister of Labour presented the details of the reform to the Council of Ministers. The fact that even individuals who were only one year away from the current statutory retirement age were affected by the reform came as a big surprise since previous pension reforms had been more gradual. We build upon the unexpectedness of the exact content of the reform to estimate the effect of a 4-month increase in minimum retirement age on the health-care consumption of individuals who were still in the labour force at the time the reform was announced.

2. Empirical Strategy

2.1. Empirical Set-Up

Our data (see Section 3) do not contain information on the employment status of individuals. Since we do not know whether they are still in the labour force, we estimate an intention-to-treat model.

Our identification strategy relies on the comparison of sickness absences, physicians' and physiotherapists' visits as well as health-care expense claims of individuals whose statutory (and ordinary) retirement ages are 4 months apart because of the reform: 60 years and 4 months *vs* 60 years old; 60 years and 8 months *vs* 60 and 4 months, etc.[3] Since the increase in SRA (and ORA) scheduled by the reform is indexed on the individual date of birth and since age strongly affects health conditions, we compare individuals whose age is as similar as possible. To do so, we define our treatment and control groups so that, across both groups, individuals' birth dates are, at most, 2 months apart.

More specifically, we consider five cohorts. Cohort C1 includes individuals born in June and July 1951. Cohort C2 pools individuals born in December 1951 and January 1952. Similarly, cohort C3 pools individuals born in December 1952 and January 1953; cohort C4, individuals born in December 1953 and January 1954; and cohort C5, individuals born in December 1954 and January 1955.[4] Within each cohort, we then compare the individuals born in the two different months, i.e. individuals born in June *vs* July 1951 for cohort C1, and individuals born in December of one year (1951 to 1954) *vs* individuals born in January of the following year (1952 to 1955) for cohorts C2, C3, C4 and C5 respectively. Thus doing, treated and control individuals all face the same gap in their minimum retirement age due to the reform (four months before the acceleration of the reform) and are all born, at most, 2 months apart.

In this set up, non-compliers are individuals for whom the increase in the statutory and ordinary retirement ages does not modify the age and conditions at which they retire. This is the case of people who have already retired by the time the reform is passed. This is also the case of individuals (in particular women) who have never worked in their entire life, and of individuals who were entitled full-pension benefits before the reform at an age which happened to be exactly the statutory retirement age after the reform (this was the case of workers who had started working at a very young age and hence benefited from the so-called long-career scheme). All other individuals are compliers. This is the case of people who planned to retire as soon as possible. This is also the case of people who planned to retire later anyway, since the reform modifies the age at which they are entitled higher pension benefits than normal – the so-called *surcote*. Of course, individuals who were planning to retire at the ordinary age because they had not contributed enough to be entitled full pension benefit before that age are also compliers since the ORA is increased by the reform.

We exclude from our analysis cohort C3, born in December 1952 and January 1953. Our identifying assumption is indeed that the difference in the health-care outcomes of the treated and control groups is only due to the reform. This is plausible for all cohorts since both groups are almost the same age and are observed over the same period of time. However, this assumption is likely violated for individuals born in December 1952 and January 1953. In fact, the Berthoin reform, passed in 1959, increased the minimum school-leaving age from 14 to 16 for children born from January 1st 1953 onward. To the extent that this school-leaving age affects careers and pension rights and may affect health outcomes (Kemptner *et al*., 2011),

3. In contrast to what is usually done in the literature, we do not estimate the effect of retirement on health outcomes using a pension reform as an instrument of retirement age. Since we do not know whether individuals are retired or not, our model is a reduced form where the pension reform directly affects health outcomes.

4. We currently do not have access to the health-consumption data of individuals born in 1956, which prevents us from extending the analysis to the cohort born in December 1955 and January 1956.

our identifying assumption likely does not hold for this cohort.

We group individuals in two different samples. The first one contains individuals from cohorts C1 and C2 who were close to retirement when the reform was passed. For them, the statutory minimum age was raised by 8 months at most (for those born in January 1952) and statutory retirement age was still on a relatively short horizon after the reform – less than 2.5 years. The second sample pools individuals from cohorts C4 and C5 who were much younger at the time of the reform. For these cohorts, retirement was delayed by a more substantial amount – from one year to one year and eight months – but, more importantly, the time horizon of retirement was distant – at least 3.5 years before the reform and 4.5 years afterwards. We group the cohorts into a younger and an older sample for several reasons. First, since the Berthoin reform potentially delayed entry on the labour market by 2 years for all individuals entering at the school leaving age in the younger group, pension entitlements were completely different across both groups of cohorts. Second, the overall increase in the retirement age was much larger in the younger than in the older sample which may have affected the way they responded to the treatment we study, i.e. an additional increase in retirement age by 4 months. As a matter of fact, 4 additional months may be considered a more marginal difference when the overall increase in the retirement age is larger than when it is smaller. Third, individuals in both samples were at different time distances from retirement before – and even more so after – the reform, which may also have affected their reactions to the reform (Bertoni *et al*, 2018). Last, while it was expected that the younger cohorts would be affected by the reform, as already mentioned, this came as a surprise for the older individuals since it amounted to changing the rules (very) late in the game. This difference may also have determined different psychological reactions to the reform, which may have, in turn, affected individuals' health in a different way. For these reasons, we choose to study the younger and older samples separately. However, as a robustness check, we re-estimate our models on a sample in which we pool the four cohorts and include cohort dummies.

To avoid considering treatments of different intensity, we focus on the period in which SRA and ORA were raised by four months for each successive cohort, i.e. before the acceleration of the reform in January 2012. This restriction is actually not binding since we want to estimate the impact of the reform on health-consumption outcomes of individuals who are not retired yet. Since the oldest individuals in our control groups may retire from June 1st 2011 – i.e. when they reach 60 years old – we consider health-care consumption over the period extending from the day following the announcement of the reform – made on July 13th 2010 – to the day before the oldest individuals in the control group reached the statutory retirement age – i.e. May 31st 2011.

To sum up, our empirical strategy consists in estimating first-difference models in which we compare the frequency and the overall number of days of sick leaves, the probability of seeing a physician or a physiotherapist and the amount of health-care expenses claimed between July 15th,[5] 2010 and May 31st, 2011, across individuals born in June and July 1951 and across individuals born in December 1951 and January 1952 (i.e. cohorts C1 and C2) , on the one hand; and across individuals born in December 1953 and January 1954 and across individuals born in December 1954 and January 1955 (i.e. cohorts C4 and C5), on the other hand. Thus doing, the treated groups face statutory and ordinary retirement ages four months higher than the control groups. We also present placebo estimates comparing individuals born in April *vs* May 1951 and individuals born in October *vs* November 1951, 1953 and 1954. For them, the statutory and ordinary retirement ages are indeed the same across placebo treatment and control groups.

2.2. Impact of the Reform on Sickness Absences

We first estimate the effect of increasing retirement age by four months on the probability of having at least one sickness absence, in our two samples, using a linear probability model:

$$SA_i = \alpha T_i + \beta D_i + \varepsilon_i \quad (1)$$

where SA_i is a dummy variable equal to 1 if individual i had at least one sickness absence starting between July 15th 2010 and May 31st 2011, and 0 otherwise. T_i is a dummy variable equal to 1 if individual i belongs to the treated group – i.e. was born in July 1951 or January 1952 in the first sample and in January 1954 or 1955 in the second sample – and 0 otherwise. D_i is a dummy variable equal to 1 if individual i belongs to cohorts C2 or C5, according to the sample, and 0 otherwise. ε_i is an error term.

5. We use July 15th instead of July 14th as our start date since July 14th is a public holiday in France so that people do not work on that day and most medical practices and pharmacies are closed.

As a second step, we consider the impact of the reform on the total number of sick days cumulated over the period ranging from July 15th 2010 to May 31st 2011. Since the latter is a highly skewed count variable with excess zero observations (about 93% of the C1+C2 sample and 89% of the C4+C5 sample) and overdispersion – the conditional variance exceeds the conditional mean – we estimate a zero-inflated negative binomial model. The model is a mixture distribution model combining two processes: the first one generates the zero counts and the second one generates counts from a binomial model:

$$\begin{cases} Pr(NSD_i = 0 \mid T_i, D_i) = \Phi\left(\vartheta T_i + \varphi D_i\right) + \\ \qquad \left(1 - \Phi\left(\vartheta T_i + \varphi D_i\right)\right) g(0 \mid T_i, D_i) \\ Pr(NSD_i \mid T_i, D_i) = \left(1 - \Phi\left(\vartheta T_i + \varphi D_i\right)\right) \\ \qquad g(NSD_i \mid T_i, D_i) \end{cases} \quad (2)$$

where NSD_i denotes the number of days individual *i* was on sick leave between July 15th 2010 and May 31st 2011 for sick leaves starting during this period. Φ is the normal link function and $g(.)$ is the negative binomial distribution.

2.3. Impact of the Reform on Physicians' and Physiotherapists' Visits

We then estimate the effect of increasing retirement age by four months on the probability of seeing a GP, a specialist physician or, alternatively, a physiotherapist. The corresponding linear probability model is:

$$V_i = \gamma T_i + \delta D_i + \vartheta_i \quad (3)$$

where V_i is a dummy variable equal to 1 if individual *i* saw a GP – or alternatively a specialist physician or a physiotherapist – at least once between July 15th 2010 and May 31st 2011, and 0 otherwise.

2.4. Impact of the Reform on Health-Care Expenditure

Finally, we investigate the impact of the increase in minimum retirement ages on health-care expenditure. Since the effect may be different according to individuals' initial health conditions, and hence health-care expenditure, we allow it to vary along the distribution of expenditure. To do so, we estimate unconditional quantile regressions. We consider the distribution of health-care expenditure of both treated and control individuals in our two samples, separately. Following Dube (2019), we denote by $Y_{i,v}$ a binary indicator equal to 1 when individual *i* has health-care expenditure greater than semi-decile – i.e. ventile – υ, and 0 otherwise. We then estimate the following linear probability model:[6]

$$Y_{i,v} = \theta_v T_i + \mu D_i + \tau_i \quad (4)$$

The set of estimated coefficients on the treatment variable, $\hat{\theta}_v$, are estimated in nineteen separate regressions. For each regression, the coefficient shows how postponing retirement by four months shifts individuals at the margin above or below the corresponding ventile of the distribution of health-care expenditure. We use these coefficients to compute the percentage change in the probability that health-care expenditure claimed by individuals be larger than each ventile of the distribution, following the announcement of the reform.

3. Data

We use the French national health insurance information system (SNIIRAM) and, more specifically, the database containing information on individual non-hospital health-care expenditure (DCIR). We focus on the general scheme which covers the universe of wage and salaried workers in the private sector as well as contract personnel working in the civil service.

The key advantage of the DCIR database is that it contains exhaustive individualised and anonymous health-care claims reimbursed by the French National Health Insurance. These claims include, in particular, sick pay, visits to a GP, a specialist physician or a physiotherapist, as well as dispensed drugs. The main drawback of these data is that, being based on Social Security files, they do not contain any socio-demographic information except gender and age. Other data sources – e.g. Hygie or EDP-Santé – contain information on both health-care consumption and individual socio-demographic and/or professional characteristics. However, they are all based on samples containing a limited number of individuals. Since our empirical strategy relies on estimating a first-difference model comparing individuals born at two different months, we need data for the entire population in order to have enough observations in the treated and control groups. This is why we use the DCIR database rather than richer but smaller datasets.

A consequence of this choice is that we have information on physicians' visits and health-care expenditure for all individuals in our population but we do not observe whether those individuals are active or inactive. We also have exhaustive

6. *We have written the corresponding code using the SAS software.*

information on sick leaves even if only individuals in employment and on unemployment benefits are eligible to such leaves.

For each individual in our database, we compute the number of sickness absences[7] which start date was strictly after July 14th 2010 and strictly before June 1st 2011. We then define a dummy variable equal to 1 if the individual had at least one sick leave, and 0 otherwise. For all individuals in our data, we also compute the total number of days of sick leave between July 15th 2010 and May 31st 2011. Regarding physicians' visits, we define two dummy variables equal to 1 when the individual saw a GP – or, alternatively, a medical specialist – at least once between July 15th 2010 and May 31st 2011, and 0 otherwise; we do the same for visits to a physiotherapist's. We also consider health-care expenditure. We aggregate all expenses[8] claimed by each individual between July 15th 2010 and May 31st 2011, separately for GPs', medical specialists' and physiotherapists' visits, as well as for drug dispensation. Expenditure is expressed in nominal euros.

Descriptive statistics of our samples are presented in Appendix Tables A-1 and A-2. The size of our cohorts ranges from 118,000 individuals in the older group (C1) to 134,000 individuals in the younger one (C5) (see Appendix Table A-2). On average, 7.1% of individuals in the C1+C2 sample had at least one sickness absence starting between July 15th 2010 and May 31st 2011 as compared to 10.7% in the C4+C5 sample (see Appendix Table A-1). It has to be noted that, although older individuals are less likely to have a sickness absence, their total number of sick days is larger than for younger individuals (38.6 days for the former as compared to 37.1 days for the latter, conditional on having a sickness absence).[9] Consistent with the fact that health conditions deteriorate with age, individuals in the older cohorts (C1 and C2) have a higher probability of seeing a GP, a specialised physician or a physiotherapist. They also spend more on these items, as well as on drugs. Whatever the cohort, men have a higher probability than women to start a sickness absence over the period we study: 7.3% *vs* 7% in the C1+C2 sample as compared to 11.7% *vs* 9.8% in the C4+C5 sample. In contrast, women are more likely to see a physician or a physiotherapist and, correspondingly, have higher expense claims on these items. Finally, drug expenditure is slightly higher for men than for women, whatever the cohort we consider.

4. Results

4.1. Sickness Absence

We first estimate the impact of postponing retirement on the probability of having at least one sickness absence starting between July 15th 2010 and May 31st 2011. The results are presented in Table 2.

For the older individuals – cohorts C1 and C2 – increasing the statutory and ordinary retirement ages by four months raises the probability of having at least one sickness absence by 0.86 and 0.72 percentage points for men and women respectively, significant at the 1% level. This represents a 11.8% increase in the probability of sick leave for men – 10.3% for women – when computed at sample average. Results are similar, although of smaller magnitude, for younger individuals (from cohorts C4 and C5): increasing minimum retirement ages by four months increases the probability of sickness absence by 6.7% and 3.9% for men and women

7. To the extent that we rely on Social Security data, we only have information on sickness absences compensated by the Social Security. These are typically absences longer than 3 days.

8. We consider health-care expenses at the rate covered by the National Health insurance. Thus doing, we exclude extra statutory fees charged to the patient, as these vary greatly across medical specialties and location.

9. A reason why older individuals are less likely to have a sick leave may be that they are more selected than younger ones if those with particularly bad health status have already left the labour market. If this is the case, our estimates are likely lower bounds since individuals in better health conditions are less likely to be strongly affected by a 4-month increase in retirement age.

Table 2 – **Impact of a 4-month increase in retirement age on the probability of having at least one sickness absence – Linear probability model**

Dep. Var At least one sickness absence	Cohorts C1 and C2		Cohorts C4 and C5	
	Men	Women	Men	Women
Treatment	0.0086***(0.0015)	0.0072***(0.0014)	0.0078***(0.0018)	0.0038** (0.0016)
Intercept	0.0622***(0.0014)	0.0644***(0.0014)	0.1127***(0.0016)	0.0933***(0.0014)
Cohort dummy	Yes	Yes	Yes	Yes
Observations	114,767	132,928	122,282	144,371

**p<0.05. ***p<0.01.

Note: Cohort C1 contains individuals born in June and July 1951. Cohorts C2, C4 and C5 contain individuals born in December 1951 and January 1952, December 1953 and January 1954, and December 1954 and January 1955, respectively. Treated individuals are born in July in cohort C1 and in January in cohorts C2, C4 and C5.

respectively.[10] The reason why the effects we estimate are smaller in the C4+C5 sample than in the C1+C2 sample may be twofold. First, individuals may be more sensitive to an increase in retirement age when they are closer to their retirement date e.g. because they had already made leisure plans and are therefore more strongly disappointed. In contrast, individuals who are further away from retirement may consider that a 4-month delay does not make much of a difference for them. Alternatively, the effect of a 4-month delay in retirement may have a decreasing effect as the overall increase in retirement ages gets larger. Since retirement is postponed by 1 year and 4 months to 1 year and 8 months for individuals in the C4 and C5 cohorts – as compared to only 4 to 8 months for individuals in the C1 and C2 cohorts – the former may be less sensitive to a marginal 4-month increase than the latter. Our data do not allow disentangling the two effects – which could also combine. However, it is worth noticing that, in all cases, the effects we estimate are surprisingly large in view of the fact that the increase in statutory and ordinary retirement ages we are considering is only four months.

We then turn to the intensive margin and consider the impact of a 4-month increase in statutory and ordinary retirement ages on the number of sick days, as estimated using a zero-inflated negative binomial model. Consistent with the results presented in Table 2, all treated individuals have a lower probability of not having any sickness absence starting between July 15th 2010 and May 31st 2011 (Table 3, first row). In contrast, conditional on having a sick leave, we do not find any evidence that delaying retirement increases the number of sick days: whether we consider men or women and younger or older cohorts, the point estimate on the treatment variable is never significant in the duration equation (Table 3, second row).[11]

To make sure that our results are due to the change in retirement ages induced by the reform, we run placebo tests for each of the preceding estimates. As regards cohorts C1 and C2, we compare individuals born in April *vs* May and October *vs* November 1951. For cohorts C4 and C5, we compare individuals born in October *vs* November 1953 on the one hand, and October *vs* November 1954, on the other hand. Whatever model we estimate, none of the results we obtain are ever significant (see Appendix Tables A-5 and A-6).

Overall, our results suggest that increasing statutory and ordinary retirement ages – even by a small amount – increases the probability that individuals have a sickness absence, whatever their age distance to retirement. In contrast, this does not seem to affect the number of sick days, conditional on having a sick leave.

These findings leave open the question of why individuals are more likely to have a sick leave when retirement ages are raised. One possibility is that they consider the reform as unfair and, to some extent, retaliate by reducing their effort. Provided that they can collude with their physician, and in particular their GP, this may give rise to more frequent sick leaves as a form of protest. This moral hazard mechanism has been put forward by d'Albis *et al*. (2020)

10. When pooling the four cohorts and including cohort fixed effects, unsurprisingly, the point estimates we find are in between those found for C1+C2 and C4+C5 separately (see Appendix Table A-3).
11. The same holds when pooling the four cohorts and including cohort fixed effects (see Appendix Table A-4).

Table 3 – **Impact of a 4-month increase in retirement age on the number of days of sickness absence – Zero-Inflated negative binomial model**

	Cohorts C1 and C2		Cohorts C4 and C5	
	Men	Women	Men	Women
	Selection equation (probability of not having a sickness absence)			
Treatment	−0.065***(0.012)	−0.054***(0.011)	−0.045***(0.010)	−0.025** (0.010)
Intercept	1.405***(0.012)	1.395***(0.011)	1.047***(0.011)	1.177***(0.010)
	Duration equation (number of days)			
Treatment	0.006 (0.036)	0.062 (0.033)	−0.014 (0.027)	−0.033 (0.027)
Intercept	3.439***(0.034)	3.335***(0.032)	3.389***(0.026)	3.372***(0.026)
Dispersion parameter α	2.997***(0.094)	2.880***(0.085)	3.172***(0.081)	2.990***(0.074)
Cohort dummy	Yes	Yes	Yes	Yes
Observations	114,767	132,928	122,282	144,371

**p<0.05; ***p<0.01.
Note: Cohort C1 contains individuals born in June and July 1951. Cohorts C2, C4 and C5 contain individuals born in December 1951 and January 1952, December 1953 and January 1954, and December 1954 and January 1955, respectively. Treated individuals are born in July in cohort C1 and in January in cohorts C2, C4 and C5.

regarding French teachers. A second possibility, however, is that when facing a change in retirement rules late in their career, individuals be subject to an acute stress episode generating, in turn, psychological or even physical health troubles. This is what De Grip *et al*. (2012) find for the Netherlands. In what follows, we try to disentangle the two explanations by considering the impact of increasing statutory and ordinary retirement ages on the probability of seeing a physician or a physiotherapist and on individual health-care expense claims.

4.2. Physicians' and Physiotherapists' Visits

We first estimate the effect of a 4-month increase in minimum retirement ages on the probability of having at least one visit with a physician in the months following the announcement of the reform. The results, shown in Table 4, suggest that postponing retirement does not increase the probability of seeing a GP, except for men in the younger cohorts. In contrast, it raises the probability of having at least one visit with a specialist physician for all individuals except men in the older cohorts, although the effect is moderate (about 1.5%). Similarly, we find that women in the older cohorts are more likely to see a physiotherapist when facing higher retirement ages, with an increase in the corresponding probability by 3.4% on average.[12]

This evidence is not quite consistent with an interpretation based on moral hazard since, in this case, we would expect treated individuals to have a greater probability of seeing their GP in order to be prescribed a sick leave. In contrast, we would not expect them to see a specialist physician more frequently since collusion with such physicians is quite unlikely. Moreover, treated women from older cohorts would have no reason to see a physiotherapist since the latter are not allowed to prescribe sick leaves. Overall, our set of results regarding physicians' and physiotherapists' visits are more in line with the idea that workers affected by changes in the pension system late in their career may suffer from psychological, or even physical, health troubles.

4.3. Health-Care Expenditure

As a second step, we estimate the effect of a 4-month increase in statutory and ordinary retirement ages on health expense claims using unconditional quantile regressions. Whenever significant, these effects are presented in Figures I to VI. For each ventile of the distribution of health-care expenditures, the graphs show how postponing retirement by four months changes the probability that expenditures claimed by individuals affected by this increase be larger than this ventile. Regarding GPs, consistent with what we find for men in the younger cohorts in Table 4, delaying retirement increases their GP's expense claims significantly. This is particularly so in the lower part of the distribution (Figure I): until the 55th percentile, the probability that expenses be higher than any given ventile increases by about 1.2% following a 4-month increase in retirement ages.

Although the effect remains positive in the upper part of the distribution, it is no longer significant since confidence intervals get larger. Regarding expense claims for specialist physicians, the effect of postponing retirement is positive for all groups except men in the older cohorts. For women in the older cohorts and men in the younger ones, the increase is modest, although significant over most of the distribution – i.e. until the 80th percentile (Figures II and III).

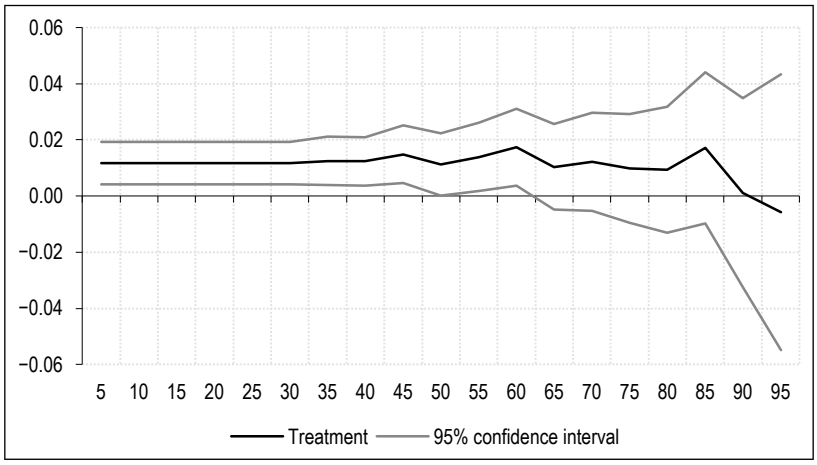
12. When pooling the four cohorts and including cohort fixed effects, the results we obtain are essentially unchanged: a 4-month increase in minimum retirement age has no effect on the probability of seeing a GP while it increases the probability of seeing a specialist physician for both men and women, and the probability of seeing physiotherapist though for women only (see Appendix Table A-7). Placebo tests are presented in Appendix Table A-8.

Table 4 – **Impact of a 4-month increase in retirement age on the probability of having at least one physician's visit – Linear probability model**

Dep. Var At least one visit	Cohorts C1 and C2		Cohorts C4 and C5	
Impact of the treatment on:	Men	Women	Men	Women
Visit to a GP	−0.003(0.002)	0.001 (0.002)	0.008***(0.002)	0.001 (0.002)
Visit to a specialist physician	0.002(0.003)	0.008***(0.003)	0.008***(0.003)	0.008***(0.002)
Visit to a physiotherapist	−0.001(0.002)	0.005** (0.002)	0.003 (0.002)	0.003 (0.002)
Cohort dummy	Yes	Yes	Yes	Yes
Observations	114,767	132,928	122,282	144,371

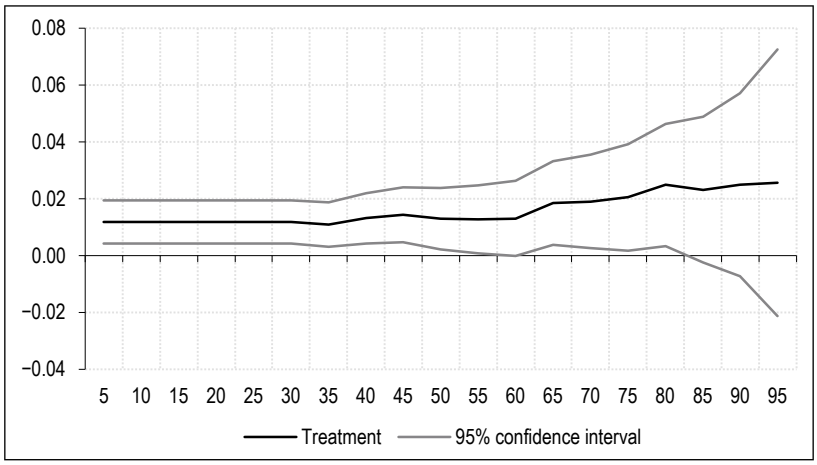
**p<0.05; ***p<0.01.
Note: Cohort C1 contains individuals born in June and July 1951. Cohorts C2, C4 and C5 contain individuals born in December 1951 and January 1952, December 1953 and January 1954, and December 1954 and January 1955, respectively. Treated individuals are born in July in cohort C1 and in January in cohorts C2, C4 and C5.

Figure I – **Impact of a 4-month increase in retirement age on the distribution of expense claims for GP visits – Men (Cohorts C4 and C5)**



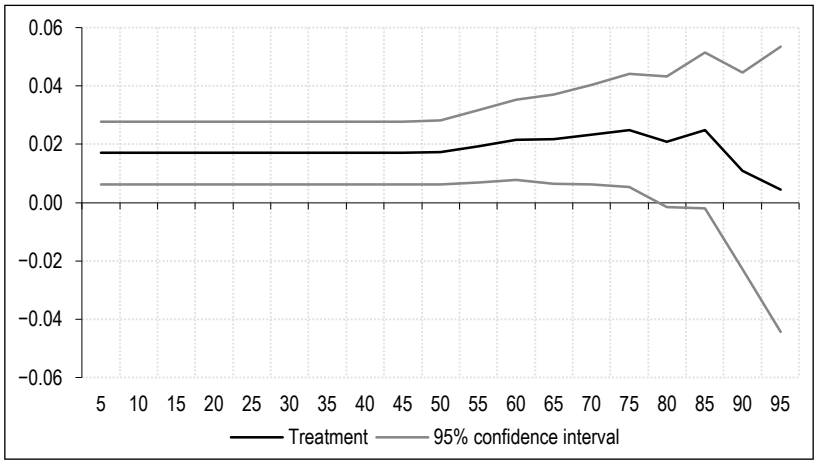
Source: Authors' calculation, based on DCIR (SNIIRAM).

Figure II – **Impact of a 4-month increase in retirement age on the distribution of expense claims for specialist physician visits – Women (Cohorts C1 and C2)**



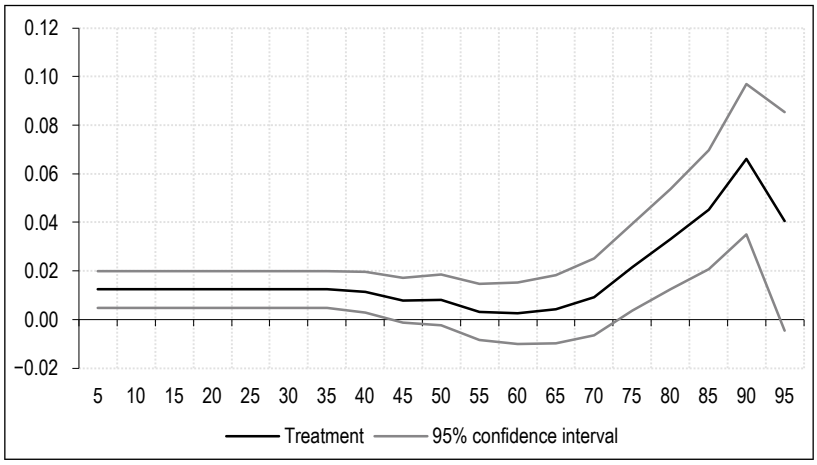
Source: Authors' calculation, based on DCIR (SNIIRAM).

Figure III – **Impact of a 4-month increase in retirement age on the distribution of expense claims for specialist physician visits – Men (Cohorts C4 and C5)**



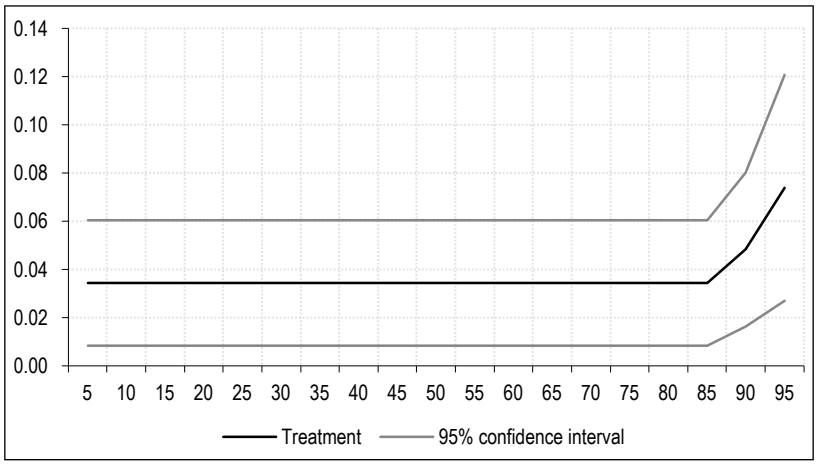
Source: Authors' calculation, based on DCIR (SNIIRAM).

Figure IV – **Impact of a 4-month increase in retirement age on the distribution of expense claims for specialist physician visits – Women (Cohorts C4 and C5)**



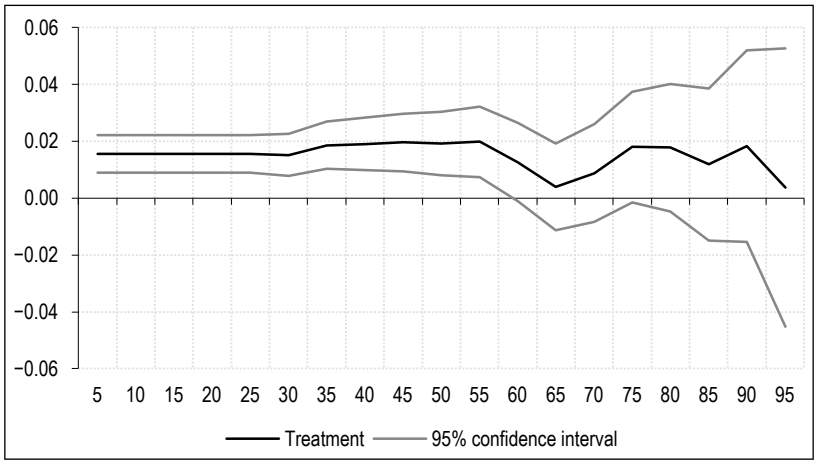
Source: Authors' calculation, based on DCIR (SNIIRAM).

Figure V – **Impact of a 4-month increase in retirement age on the distribution of expense claims for physiotherapy – Women (Cohorts C1 and C2)**



Source: Authors' calculation, based on DCIR (SNIIRAM).

Figure VI – **Impact of a 4-month increase in retirement age on the distribution of expense claims for drug dispensation – Men (Cohorts C4 and C5)**



Source: Authors' calculation, based on DCIR (SNIIRAM).

For younger women, the probability that specialist physicians' expenses be higher than any given ventile increases by about 1.2% until the 40th percentile; it remains unchanged in the middle of the distribution but increases again – by 2 to 6% – between the 75th and 85th percentiles (Figure IV).

As regards physiotherapists' expenditure, consistent with the results presented in Table 4, we find that delaying retirement increases expense claims for women in the older cohorts: the probability that expenses be higher than any given ventile increases by about 3.4% until the 85th percentile[13] and even more so, in the upper part of the distribution (Figure V).

Finally, drug expenditure of treated men in the younger cohorts also increases following a 4-month increase in retirement age: the probability that expense claims be higher than any given ventile increases by 1.5% to 2% until the 60th percentile. The effect remains stable higher up in the distribution but confidence intervals get larger so that it is no longer significant at the 5% level (Figure VI).

Overall, our findings suggest that increasing minimum retirement ages by four months has a non-negligible effect on health-care expenditure generated by physicians' and physiotherapists' visits, as well as drug dispensation. This pattern of results is consistent with a deterioration of the health conditions of individuals affected by the reform and supports the idea that the increase in the probability of sick leave that we observe in reaction to the reform is not only generated by moral hazard.

* *
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In this paper, we have investigated the health-consumption effects of a 4-month increase in retirement age, on individuals who were close to retirement age but had not yet retired by the time the reform was passed. We show that the probability of having at least one sickness absence increases by 11.8% for men and 10.3% for women in the older cohorts, and by 6.7 and 3.9% respectively in the younger ones. These effects are surprisingly large in view of the fact that the increase in retirement age we are considering is only one third of a year. In contrast, we do not find any effect of the reform on the overall number of sick days, conditional on having a sick leave. In addition, increasing retirement age by four months does not raise the probability of seeing a GP, except for men in the younger cohorts. In contrast, it increases the probability of having at least one visit with a specialist physician for all individuals except men in the older cohorts, although the effect is limited in size (about 1.5%). Delaying retirement also increases the probability of seeing a physiotherapist by 3.4% among women in the older cohorts. Consistent with these results, we find increases in expense claims, in particular for treated individuals with low initial levels of health expenditure, in reaction to the reform.

Our findings are not quite consistent with an interpretation of the increase in the frequency of sickness absences as driven by moral hazard such as the one put forward by d'Albis *et al.* (2020). If sick leaves were merely a form of protest, we would expect to see a higher probability of visiting a GP since family physicians are more likely to collude with workers than specialist physicians. Moreover, physiotherapists' visits and drug consumption would have no reason increase. The moral hazard interpretation is not supported by our data since we observe an increase in specialists' and physiotherapists' visits, along with higher drug expenditure, in particular at the bottom of the distribution. In contrast, these findings are consistent with the idea put forward by De Grip *et al*. (2012) according to which individuals affected by adverse changes to the pension system late in their career experience a severe disappointment. A plausible mechanism is that this generates an upsurge in stress which eventually induces psychological, and even physical, health troubles.

To the extent that we estimate an intention-to-treat model, our results are likely to represent a lower bound. Individuals who have already left the labour market by the time we observe their health expense claims are indeed non compliers. Since the literature has shown that the latter tend to be in poorer health than individuals who are still in employment (Kuhn, 2018), our effects are estimated on a selected sample of individuals whose health is likely more resistant to external shocks than average.

One caveat though is that the period we study spans the ten months and a half following the announcement of the reform. As a consequence, the effects we estimate are mechanically short run and we do not know whether they may persist in the medium and long run or not. Nonetheless,

13. All percentiles being equal up to the 85th, the effect of the treatment is the same up to that level.

we can safely conclude that increasing retirement age by four months has a large effect on the probability of sick leave and a non-negligible impact on health-care expenditure, at least in the months following the announcement of the reform.

One may wonder how a 4-month increase in retirement age may have such a substantial effect on health-care consumption. A first mechanism may be that individuals who were close to retirement had made leisure plans which are deceived by the reform. Bitter disappointment may generate psychological distress which may, in turn, affect physical wellbeing. This will likely affect more strongly older cohorts who were closer to retirement age than younger ones who were already quite far away from the end of their career before the reform was passed. A second – potentially complementary – mechanism is that individuals who were suffering from psychological or physical disorders (e.g. musculoskeletal disorders, pain, etc.), and who used to cope with it as best they could, decide that they have to seek medical help since they will have to work longer. This potentially affects all cohorts since older ones suffer probably more from health troubles to start with, but younger ones face a larger increase in retirement age overall, which may affect the way they react to the marginal 4-month increase we consider here.

Overall, our results suggest that delaying retirement may have negative health effects, not only at old ages – as suggested in the literature – but also earlier on, when individuals are still in employment. This may thwart the financial gains expected from an increase in retirement ages and must be taken into account when designing reforms aiming at the sustainability of pension, and more generally, social systems. □

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APPENDIX

Table A-1 – **Descriptive statistics**

Variable	All		Men		Women	
	C1+C2	C4+C5	C1+C2	C4+C5	C1+C2	C4+C5
Men						
Mean	0.463	0.458	-	-	-	-
Standard Deviation	0.498	0.498	-	-	-	-
At least 1 sickness absence						
Mean	0.071	0.107	0.073	0.117	0.070	0.098
Standard Deviation	0.026	0.309	0.260	0.321	0.255	0.297
Number of sick days (if >0)						
Mean	38.63	37.14	40.02	37.38	37.99	36.28
Standard Deviation	55.53	54.71	57.33	53.82	55.84	53.52
At least 1 visit to the GP's						
Mean	0.733	0.707	0.723	0.688	0.741	0.723
Standard Deviation	0.442	0.455	0.447	0.463	0.438	0.447
At least 1 specialist visit						
Mean	0.619	0.593	0.561	0.523	0.669	0.652
Standard Deviation	0.485	0.491	0.496	0.499	0.470	0.476
At least 1 visit to the physiotherapist's						
Mean	0.127	0.123	0.106	0.103	0.145	0.140
Standard Deviation	0.333	0.328	0.308	0.303	0.352	0.347
Expenditure on GP visits						
Mean	72.99	68.89	68.92	63.09	76.52	73.81
Standard Deviation	97.98	97.55	96.62	94.28	99.00	99.97
Expenditure on specialists' visits						
Mean	98.50	90.58	83.63	73.58	111.3	104.9
Standard Deviation	190.5	181.2	181.6	169.6	196.9	189.3
Expenditure on physiotherapy						
Mean	32.27	30.68	28.61	27.67	35.43	33.23
Standard Deviation	145.5	140.4	143.2	141.2	147.4	139.6
Drug expenditure						
Mean	275.6	239.5	303.1	255.7	251.8	225.7
Standard Deviation	537.8	217.3	575.3	551.1	502.0	486.4

Note: Individuals belonging to C1 and C2 are born in June, July and December 1951, as well as January 1952. Individuals belonging to C4 and C5 are born in December 1953, January 1954, December 1954 and January 1955.

Table A-2 – **Number of individuals per month of birth**

Month of birth	All	Men	Women
April 1951	58,180	26,575	31,605
May 1951	60,490	27,822	32,668
June 1951 (Cohort C1)	57,568	26,527	31,041
July 1951 (Cohort C1)	60,129	27,557	32,572
October 1951	54,787	25,030	29,757
November 1951	50,670	23,187	27,483
December 1951 (Cohort C2)	61,540	28,378	33,162
January 1952 (Cohort C2)	68,329	32,305	36,153
October 1952	56,777	26,156	30,621
November 1952	54,390	24,761	29,629
December 1952 (Cohort C3)	64,025	29,312	34,713
January 1953 (Cohort C3)	68,329	31,746	36,583
October 1953	52,452	25,513	29,911
November 1953	55,424	24,244	28,208
December 1953 (Cohort C4)	64,095	29,310	34,785
January 1954 (Cohort C4)	68,641	31,641	37,000
October 1954	58,391	27,015	31,376
November 1954	54,915	25,145	29,770
December 1954 (Cohort C5)	65,210	29,794	35,424
January 1955 (Cohort C5)	68,699	31,537	37,162

Table A-3 – **Impact of a 4-month increase in retirement age on the probability of having at least one sickness absence – Linear probability model – Pooled sample**

Dep. Var At least one sickness absence	Men	Women
Treatment	0.0082***(0.0015)	0.0054***(0.0011)
Intercept	0.1134***(0.0013)	0.0987***(0.0012)
Cohort C1	−0.051*** (0.0012)	−0.033*** (0.0015)
Cohort C2	−0.039*** (0.0017)	−0.029*** (0.0014)
Cohort C4	−0.00009 (0.0017)	−0.006*** (0.0014)
Cohort C5	*Ref.*	*Ref.*
Observations	237,049	277,299

**p<0.05; ***p<0.01.
Note: Cohort C1 contains individuals born in June and July 1951. Cohorts C2, C4 and C5 contain individuals born in December 1951 and January 1952, December 1953 and January 1954, and December 1954 and January 1955, respectively. Treated individuals are born in July in cohort C1 and in January in cohorts C2, C4 and C5.

Table A-4 – **Impact of a 4-month increase in retirement age on the number of days of sickness absence – Zero-inflated negative binomial model – Pooled sample**

	Men	Women
	Selection equation (probability of not having a sickness absence)	
Treatment	−0.054***(0.008)	−0.037***(0.007)
Intercept	1.049***(0.009)	1.146***(0.009)
Cohort C1	0.342***(0.011)	0.235***(0.011)
Cohort C2	0.247***(0.011)	0.205***(0.011)
Cohort C4	0.007 (0.010)	0.041***(0.010)
Cohort C5	*Ref.*	*Ref.*
	Duration equation (number of days)	
Treatment	−0.007 (0.022)	0.004 (0.021)
Intercept	3.356***(0.023)	3.318***(0.022)
Cohort C1	0.076** (0.033)	0.040 (0.031)
Cohort C2	0.077***(0.030)	0.063** (0.029)
Cohort C4	0.037 (0.027)	0.040 (0.027)
Cohort C5	*Ref.*	*Ref.*
Dispersion parameter α	3.105***(0.061)	2.947***(0.056)
Observations	237,049	277,299

**p<0.05; ***p<0.01.
Note: Cohort C1 contains individuals born in June and July 1951. Cohorts C2, C4 and C5 contain individuals born in December 1951 and January 1952, December 1953 and January 1954, and December 1954 and January 1955, respectively. Treated individuals are born in July in cohort C1 and in January in cohorts C2, C4 and C5.

Table A-5 – **Placebo Test: impact of a 4-month increase in retirement age on the probability of having at least one sickness absence – Linear probability model**

Dep. Var At least one sickness absence	Cohorts C1 and C2		Cohorts C4 and C5	
	Men	Women	Men	Women
Treatment	−0.0012 (0.0015)	0.0027 (0.0015)	0.0038 (0.0021)	0.0029 (0.0018)
Intercept	0.0633***(0.0013)	0.0639***(0.0012)	0.1191***(0.0018)	0.1025***(0.0015)
Cohort dummy	Yes	Yes	Yes	Yes
Observations	102,614	121,513	101,917	119,265

**p<0.05; ***p<0.01.
Note: Cohorts C1 and C2 pool individuals born in April, May, October and November 1951. Cohorts C4 and C5 pool individuals born in October and November 1953 and 1954. “Treated” individuals are born either in May or in November.

Table A-6 – **Placebo Test: impact of a 4-month increase in retirement age on the number of days of sickness absence – Zero-inflated negative binomial model**

Dep. Var Number of days of sickness absence	Cohorts C1 and C2		Cohorts C4 and C5	
	Men	Women	Men	Women
	Selection equation (probability of not having a sickness absence)			
Treatment	0.011 (0.013)	−0.021 (0.012)	−0.020 (0.011)	−0.017 (0.011)
Intercept	1.396***(0.013)	1.401***(0.035)	1.000***(0.012)	1.107***(0.011)
	Duration equation (number of days)			
Treatment	0.039 (0.039)	0.013 (0.035)	0.002 (0.030)	−0.017 (0.029)
Intercept	3.444***(0.037)	3.407***(0.032)	3.354***(0.028)	3.321***(0.027)
Dispersion parameter α	3.041***(0.107)	2.876***(0.090)	3.283***(0.092)	3.133***(0.085)
Cohort dummy	Yes	Yes	Yes	Yes
Observations	102,614	121,513	101,917	119,265

**p<0.05; ***p<0.01.
Note: Cohorts C1 and C2 pool individuals born in April, May, October and November 1951. Cohorts C4 and C5 pool individuals born in October and November 1953 and 1954. “Treated” individuals are born either in May or in November.

Table A-7 – **Impact of a 4-month increase in retirement age on the probability of having at least one physician's visit – Linear probability model – Pooled sample**

Impact of the treatment on:	Men	Women
Visit to a GP	0.003 (0.002)	0.0005 (0.002)
Visit to a specialist physician	0.005*** (0.002)	0.007*** (0.002)
Visit to a physiotherapist	0.001 (0.001)	0.004*** (0.001)
Cohort dummies	Yes	Yes
Observations	237,049	277,299

**p<0.05; ***p<0.01.
Note: Cohort C1 contains individuals born in June and July 1951. Cohorts C2, C4 and C5 contain individuals born in December 1951 and January 1952, December 1953 and January 1954, and December 1954 and January 1955, respectively. Treated individuals are born in July in cohort C1 and in January in cohorts C2, C4 and C5. Our model controls for 4 cohort dummies; cohort C5 is the reference.

Table A-8 – **Placebo test: impact of a 4-month increase in retirement age on the probability of having at least one physician's visit – Linear probability model**

Dep. Var	Cohorts		Cohorts	
At least one visit	C1 and C2		C4 and C5	
Impact of the treatment on:	Men	Women	Men	Women
Visit to a GP	−0.001(0.003)	0.001(0.002)	0.001(0.003)	0.004(0.002)
Visit to a specialist physician	0.001(0.003)	−0.001(0.003)	0.005(0.003)	0.002(0.003)
Visit to a physiotherapist	−0.003(0.002)	0.002(0.002)	0.001(0.002)	0.001(0.002)
Cohort dummy	Yes	Yes	Yes	Yes
Observations	102,614	121,513	101,917	119,265

**p<0.05; ***p<0.01.
Note: Cohorts C1 and C2 pool individuals born in April, May, October and November 1951. Cohorts C4 and C5 pool individuals born in October and November 1953 and 1954. "Treated" individuals are born either in May or in November.

Does the Right to Information on their Pension Introduced by the 2003 Reform Make the French Better Informed and Less Concerned about their Future Pension?

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Abstract – We study the impact of the policy of sending policyholders personalised information regarding their pension, which was introduced by the 2003 reform (the right to information, *Droit à l'information* – DAI), on improving their knowledge of their pension entitlements and on the changes in their level of concern regarding their future pension amount. By using data from the 2012 and 2020 waves of the PAT€R survey, we show that knowledge of pension entitlements improved and that concern regarding pension amounts fell between 2012 and 2020. The impact of sending information as part of the DAI is difficult to isolate from the impact of the change in the general context between 2012 and 2020. However, the results obtained suggest that the first documents sent under the DAI policy have a slight positive effect on knowledge and an indirect impact on reducing concern by improving knowledge.

JEL: H55, I20, J26
Keywords: retirement, provision of information, financial literacy, pension expectations

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Recurring debates on the best way to ensure the financial balance of pension systems, within a context of marked population ageing, focus primarily on pension levels and the retirement age. To explain pension savings behaviour, the standard model used is the life-cycle model and its extensions (Modigliani & Brumberg, 1954). The basic idea behind this model is simple: individuals save for their pension throughout their working life and then use the savings accrued in this way in old age. If there is a public pension system that provides a life annuity, any savings held by the individual will be reduced by that amount. The savings (private and pension entitlements) are used to match the schedule of needs with the schedule of resources, which exhibit systematic variations (entry into retirement) and random shocks or fluctuations. However, in the light of the empirical data, this "standard rationality" presents several puzzles, including, in terms of pensions, the inadequacy of saving for a proportion of the population, and the low spread of savings plans with life annuities (annuity puzzle), even after the age of 50 (Davidoff *et al.*, 2005).

To address these shortcomings of the standard model, "non-standard" models of behavioural economics can be used. These reconsider the saver's rationality hypothesis (Gomes *et al.*, 2021) whether in terms of their choices, their beliefs, or even the processes by which they make their decisions (DellaVigna, 2009). For example, disaffection for life annuities could be explained by "an aversion to ambiguity" (which relates to choices in an uncertain environment rather than a risky environment as explained by Knight − Ellsberg, 1961) exhibited by individuals in times of uncertainty regarding their longevity (Guiso & Sodini, 2013). Questioning the hypothesis of rational expectations, and in particular, the homogeneity of beliefs, also seems to be an interesting research pathway. Lastly, the standard model implicitly assumes that, in making their decisions, savers are familiar with economic and financial concepts such as discounting, inflation, interest calculation, etc., and that they have a certain level of information about the economic environment, in particular the pension systems and their entitlements. The research programmes on information, financial literacy or cognitive ability tend to show that these hypotheses are not always true (Lusardi & Mitchell, 2014).

For example, savers may suffer from a lack of financial education ("financial illiteracy") or limited cognitive ability (Lusardi, 2009; Guiso & Sodini, 2013). They may not be familiar with the economic principles required (rational formation of expectations, discounting calculation, valuation of assets, etc.) or may not have sufficient knowledge of financial products or the economic environment (interest rates, stock markets, pension system, etc.). They may make all sorts of "errors", for example of calculation, of strategy, and also expectation errors, in obtaining and processing information or establishing their beliefs. They may be victims of "emotions" that run counter to their own interests (impulsiveness, excess self-confidence, unjustified regret or disappointment, etc.). These various "biases" could therefore be behind inadequate preparation for retirement.

From this perspective, this article focuses on the knowledge that French people have of their personal pension entitlements and their concern in terms of their future pension, which have more financial aspects. More specifically, we are looking at how their knowledge and concern changed following the implementation of a mechanism for the systematic provision of information to policyholders throughout their careers by public actors and pension schemes. The 2003 pension reform tasked the *GIP-Info retraite* (the Retirement Information Public Interest Group, which became the *GIP-Union retraite* (Retirement Union Public Interest Group) following the 2014 reform) with implementing the right to information (*Droit à l'information*, DAI). This right is reflected in the sending of consolidated information to non-retired members, every five years from the age of 35, regarding their entitlements under the various mandatory pension schemes. Here, we direct our attention more specifically to the intention-to-treat (ITT) assessment of this policy, i.e. on the fact that it is the individuals who are the target of this DAI document provision policy and not on the circumstance of having actually received a right to information (for more details on the DAI policy and on measuring ITT, see Box 1).

According to several studies, "lack of money" for retirement is the main source of concern for future pensioners (Arrondel & Soulat, 2017). We therefore consider it to be useful to take a look at the extent to which the DAI can improve the confidence of individuals in having sufficient income once retired. The DAI policy is indeed also likely to have an impact on the level of concern regarding personal pension amounts, in addition to its direct effect on the level of awareness of personal entitlements. We therefore examine the effects of exposure to the DAI

Box 1 – **Right to Information (*Droit à l'information* – DAI)**

The 2003 pension reform tasked the GIP-Info retraite (the Retirement Information Public Interest Group), which became the GIP-Union retraite (Retirement Union Public Interest Group Union) in 2014, with sending consolidated information to non-retired members, every five years from the age of 35, regarding their entitlements under the various mandatory pension schemes: the sending of this information constitutes the right to information on retirement (*Droit à l'information* – DAI). Before the age of 55, this takes the form of an individual pension entitlements statement (*Relevé individuel de situation* – RIS) followed by an overall indicative estimate (*Estimation indicative globale* – EIG), which provides an assessment of the total pension amount based on a number of assumptions concerning retirement age and end-of-career status (COR, 2008). The DAI was implemented gradually from 2007 onwards. If we take account of the information sent up until 2019 for the 2020 wave of the PAT€R survey, the generation born between 1975 and 1984 received the RIS upon reaching the age of 35 from 2010 onwards; the generation born between 1969 and 1974 received the RIS upon reaching the age of 40 from 2009 onwards; the generation born between 1963 and 1968 received the RIS upon reaching the age of 45 from 2008 onwards; and the generation born between 1957 and 1967 received the RIS upon reaching the age of 50 from 2008 onwards. The sending of EIGs to those aged 55, 60 and 65 was also increased gradually. The schedule for scaling up the scheme for the first generation of beneficiaries may have resulted in several DAI being received more frequently than every five years. The first beneficiaries, born in 1949, were 58 years old in 2007, with those born before 1949 not being targeted as recipients. Finally, the sending of information within the scope of the DAI ceases upon the liquidation of pension entitlements.

In this study, we are interested in exposure to the sending of RIS or EIG within the framework of the DAI and not the actual receipt of these documents. Such exposure is entirely determined by the year of birth, since the schedule for sending the information is dependent on that year of birth. It is therefore an assessment of the "intention to treat" (ITT). This measure may overestimate the number of people who have actually received a document within the scope of the DAI, since sending may have been suspended for technical reasons or may not have reached the policyholder due to an incorrect address, for example.

$DAI_{i,t}$ is the total number of documents sent in theory before date *t* to person *i*. For the 2012 wave, it therefore relates to the total number of documents sent between 2007 and 2011 and, for the 2020 wave, the total number of documents sent between 2007 and 2019. It is assumed that the people targeted by the sending of information during the survey year (2012 or 2020) did not receive the document until after they had completed the survey. It is a measure of the intensity of the sending of DAI.

If we take the example of respondent *i*, born in 1957 and retired in 2019 at the age of 62, $DAI_{i,t=2012} = 1$ since they were only sent a single RIS when they turned 50 years old in 2007 (at which date *i* had not yet retired), and $DAI_{i,t=2020} = DAI_{i,t=2012} + 2 = 3$ with the additional sending of an EIG when they reached 55 years of age in 2012 and a further EIG when they reached 60 years of age in 2017 (at which dates the individual had not yet retired).

In 2012, 45.9% of respondents had, in theory, received a document within the framework of the DAI, with 6.4% having theoretically received two documents; in 2020, 11.0% had, in principle, received a single document within the framework of the DAI, 46.7% had received two and 14.3% had received at least three (Table A).

Table A – **Proportion of individuals targeted by the sending of DAI according to the number sent (as a %)**

Age	2012 DAI=0	2012 DAI=1	2012 DAI=2	2020 DAI=0	2020 DAI=1	2020 DAI=2	2020 DAI=at least 3
	All respondents (*N*=3895)						
Under 35	100.0	0.0	0.0	100.0	0.0	0.0	0.0
35-49	41.1	58.9	0.0	4.7	30.8	64.5	0.0
50 and over	11.0	70.1	18.8	0.3	0.3	62.1	37.4
Total	47.7	45.9	6.4	28.0	11.0	46.7	14.3
	Respondents included in both waves (*N*=444)						
Under 35	100.0	0.0	0.0	100.0	0.0	0.0	0.0
35-49	42.9	57.1	0.0	3.1	22.6	74.2	0.0
50 and over	17.9	78.6	3.6	0.0	0.0	64.7	35.3
Total	49.5	49.5	0.9	11.0	8.1	61.7	19.1

Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents.

on the level of and increase in knowledge of personal entitlements, on the level of and change in concern regarding personal pension entitlements, and on the relationship between the levels of knowledge and concern.

To that end, we use data from the 2012 and 2020 waves of the PAT€R survey (*PATrimoine et Préférences vis-à-vis du TEmps et du Risque* – Savings and preferences regarding time and risk), the only waves that have a module on French expectations and preferences regarding retirement. One group of respondents is included in both waves. We offer an analysis of the factors determining the levels and changes between 2012 and 2020 in both the knowledge

of personal pension entitlements and concern regarding personal entitlements.

In the first section, we present the PAT€R survey. In the second section, we provide details on the construction of the indicators for knowledge and concern regarding personal pension entitlements, before describing the levels of knowledge and concern regarding pension entitlements by exposure to the DAI policy (with all other things being equal). In the third section, we attempt to explain the changes in knowledge and concern between 2012 and 2020.

1. The PAT€R Survey: Panel Information on Retirement Expectations and Preferences

The PAT€R survey aims to analyse the savings and asset accumulation behaviour of French people based on their preferences, in particular with regard to risk (risk aversion) and time (preference for the present). It has seven waves (2002, 2007, 2009, 2011, 2012, 2014 and 2020) partly in panel. This study is based on the 2012 and 2020 waves,[1] which are the only ones to contain a module on pension preferences and expectations.

They were conducted by post by Kantar (the first between 10 September and 12 October 2012 and the second between 19 March and 8 June 2020) on a representative sample of the French population aged 18 and over.

To measure the level and change in knowledge and concern between 2012 and 2020, and the role that the sending of DAI documents may have played, we only include individuals concerned with their future pension entitlements. Those who are already pensioners are therefore excluded from the study.

The sample chosen for the 2012 wave comprises 1,835 non-pensioners, and that of the 2020 wave comprises 2,060 non-pensioners, 444 of whom are included in both waves. Table A1-1 in Appendix 1 shows some of the characteristics of the respondents. The 2012 and 2020 waves differ in particular in the ageing of the respondents, which is, on average, around 1 year and 8 months. The sample that is common to both waves has aged mechanically by 7 years and 9 months (the time period between the two waves).

The two waves also stand out due to the increase in the provision of DAI information: the proportion of respondents sent at least one DAI document increased by 19.7 points between 2012 and 2020, and by 38.5 points for those respondents common to both waves.

One specific feature of the 2020 wave that was not anticipated was that the respondents completed their questionnaire during the first lockdown imposed due to the COVID-19 health crisis,[2] which may have affected their preferences (risk aversion, preference for leisure, etc.) or their knowledge and concerns regarding the pension system and their entitlements.

There are several empirical studies seeking to test whether preferences can be altered by life events (health problems, death of relatives, unemployment, financial losses, etc.) and structural shocks (natural disasters, wars, economic crises, etc.) faced by the individuals. Chuang & Schechter (2015) identify studies on the impact that these shocks have on risk aversion, preference for the present and social preferences. The results are mixed, with the effects not always moving in the same direction. Schildberg-Hörisch (2018) is unable to reach any conclusive results by studying preferences when faced with risk: the results depend on the source of the shocks, the methodology used to measure preferences (experience, survey) and the nature of the questions asked (lottery, scale, score, etc.). Regarding the effects of the COVID-19 pandemic, there is no consensus on how the health shock and the economic shock that followed impacted individual preferences: see, in particular, Goossens & Knoef (2022) on the Netherlands, Müller & Rau (2021) on German households, Shachat *et al*. (2020) on Wuhan province in China, Drichoutis & Nayga (2022) on Greece, and Angrisani *et al*. (2020) on the behaviour of a group of traders and students in the USA.

Furthermore, it seems unlikely that, in the case of France, the responses to the PAT€R survey were significantly affected by the suspension of the planned pension reform as a result of the lockdown.[3] As such, the health crisis may have led to a shift in people's concerns, which may have focused more on health issues, leading

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1. The 2012 and 2020 waves are the result of collaborative efforts between the managers of the PAT€R survey, Luc Arrondel (PSE-CNRS), André Masson (PSE-CNRS) and the Caisse des Dépôts.

2. The first lockdown ran from 17 March to 11 May 2020; only 2% of questionnaire responses were received after 11 May 2020.

3. The suspension of the planned pension reform should a priori *lead to an increase in concern regarding personal entitlements for people in favour of the reform, and a decrease in concerns regarding personal entitlements for those who are against it. Between 2012 and 2020, the average concern score fell by 7.9% for people in favour of the reform and by 6.2% for those against it. In the same way, with this suspension, people over the age of 50, whose pension entitlements are not subject to the planned reform, could be expected to experience a lower drop in their concern regarding their pension entitlements than those under the age of 50, whose entitlements may have been affected by the reform. However, concern regarding personal pension entitlements fell by 7.9% between 2012 and 2020 for people aged 50 and over in 2020, while it fell by only 6.3% for those aged under 50 in 2020.*

to a reduction in concern for personal pension entitlements (Brodeur *et al*., 2021).

Furthermore, the levels and changes in knowledge and concern regarding pension entitlements may *a priori* be attributable to at least three distinct causes, including the context in which respondents were interviewed. For example, the levels in 2020, when compared to those of 2012, may firstly be the consequence of the ageing of the population interviewed between the two waves, which was 7 years and 9 months for those common to both waves: as retirement age approaches, respondents' knowledge of their entitlements improves (because they take a greater interest in their pension or will seek information about their entitlements) and their concern regarding any unwelcome surprises in terms of the entitlements acquired reduces (reduction in the likelihood of a new reform that would apply to them, reduction in uncertainty regarding reference salary and the length of insurance acquired to receive a full pension).

Secondly, the changes in the scores may reflect the impact of the provision of information with the ramp-up in the sending of DAI documents. Thus, the increase in the total number of documents sent under the DAI should directly improve knowledge of pension entitlements and, possibly, reduce concern about these entitlements.

Thirdly, the changes in knowledge and concern scores may also be the consequence of a more general change in the interview context between 2012 and 2020, irrespective of respondent characteristics. The 2020 wave was carried out just after the national debate on the French pension system (the citizens' consultation on pensions), the publication of the report "*Pour un système universel de retraite*" [For a universal pension system] (Delevoye, 2019), and then the tabling of a systemic reform bill that caused major social movements in late 2019 and early 2020. This context improved the information available on the functioning of the pension system in general (and in particular on the methods of calculating pension entitlements) for all French people, and led a significant number of them to consider their own pension situation more closely. Conversely, it is conceivable that the universal system reform bill could have increased the perception that the current pension system is complex and thereby increased concern compared with the 2012 wave.

The 2012 wave also took place in a context of various interlocking reforms relating to both the length of insurance required to receive a full pension (2003 reform) and the increase in the legal age of entitlement (2010 reform). This interlocking of reforms could have caused confusion between the two mechanisms postponing retirement (age and length of insurance) for those surveyed during the 2012 wave, a confusion that probably lessened over time, such that it would be less widespread in 2020. Lastly, the improvement in knowledge and the reduction in concern may also be seen as the consequence of the progressive increase in importance of the issue of pensions in the public debate: over the last 30 years, the reports (notably following the creation of the *Conseil d'orientation des retraites* – Pension Advisory Board, COR) and reforms have built up, while efforts to provide education and information have intensified (DAI, pension simulators, etc.).

With only two survey waves, it is, however, difficult to distinguish the impact of these various factors on the change in knowledge and concern that French people have about their pension entitlements.

2. Scores for Measuring Knowledge and Concern Regarding Personal Pension Entitlements

Relying on the responses to a single survey question taken in isolation in order to assess the level of knowledge of pension entitlements and concern about future pensions can lead to bias. This is why we have preferred the use of scores (or synthetic indicators) that simultaneously use the responses to several questions each addressing the issue concerned in a slightly different way.[4]

2.1. Greater Knowledge of Personal Pension Entitlements Among People to Whom the DAI Documentation Is Sent

The knowledge score for personal pension entitlements is calculated using a quiz with three questions: about the knowledge that the person has regarding the number of quarters already accrued, the number of quarters still to be accrued to receive a full pension, and retirement age. The "correct" answers to the last two questions are calculated based on the respondent's characteristics: year of birth, status (possibility of early retirement due to "*catégorie active*" (active category) status for civil servants), number of quarters already accrued (for assessing age of entry onto the job market and

4. For more details on the development of the knowledge and concern scores for the 2012 wave, see Arrondel et al. *(2013); for the 2020 wave and a comparison between 2012 and 2020, see Arrondel* et al. *(2021). Box 2 discusses the questions used to build the scores.*

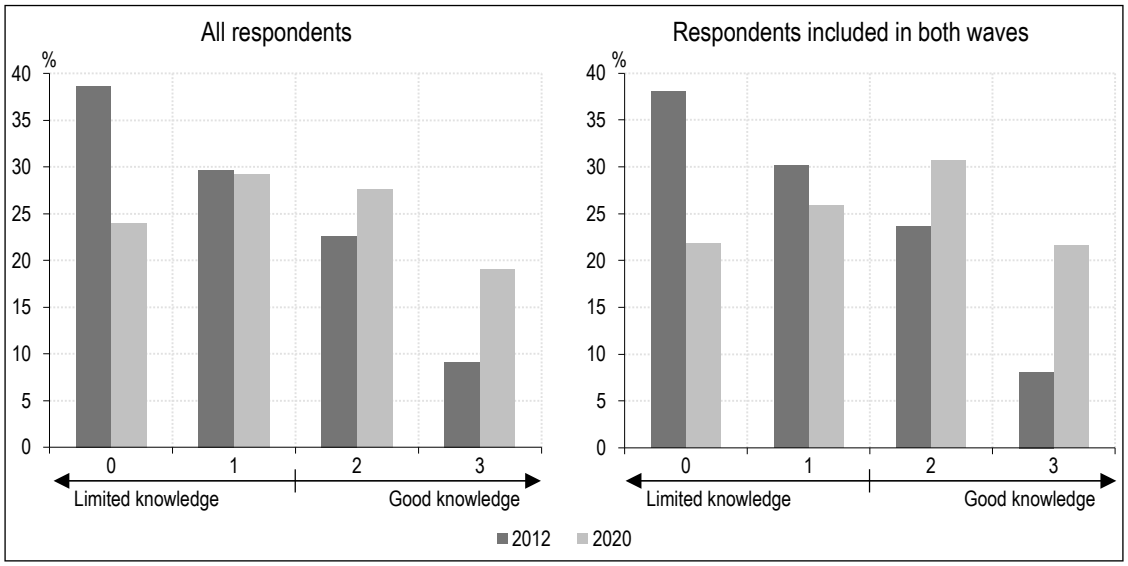
the possibility of early retirement due to a long career), number of children (for assessing the possible increase in length of insurance) (Soulat, 2017). Each correct answer gives 1 point, each incorrect answer gives 0. The score is the total points. It varies between 0 and 3, where 0 means zero knowledge, 1 limited knowledge, 2 good knowledge and 3 very good knowledge of pension entitlements.

In 2020, a little under half of the people surveyed (46.8%) had good or very good knowledge of their personal entitlements (Figure I). The majority of respondents know the number of quarters already accrued and the age at which they are entitled to pension benefits, although fewer are aware of the length of insurance that will allow them to avoid a reduction, which depends on their year of birth.

The higher the number of documents supposed to have been sent to the respondent under the DAI,[5] the higher the level of knowledge

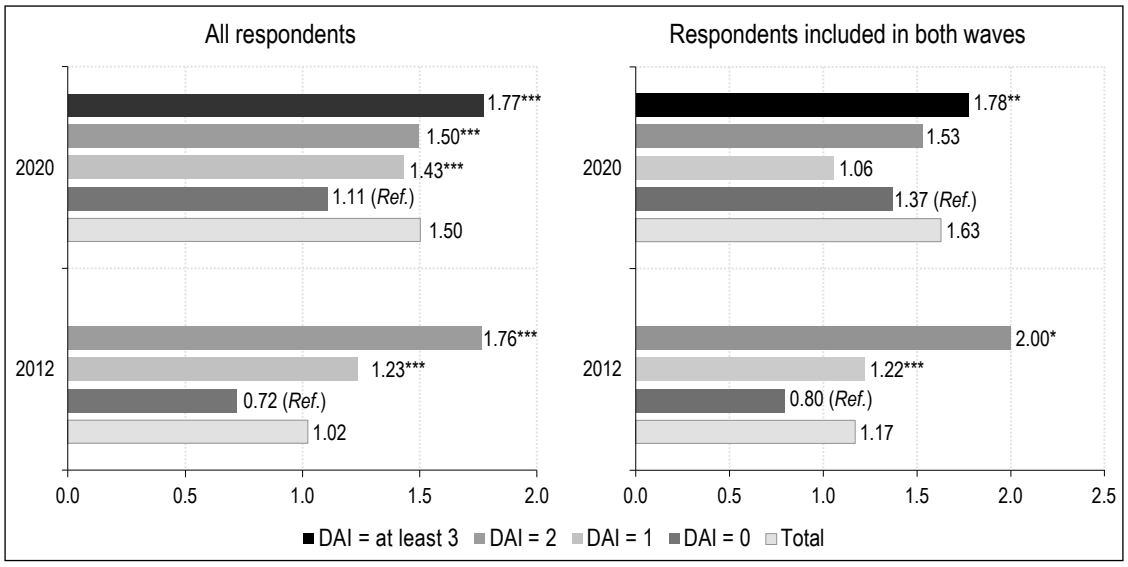
5. Among the population of respondents common to both waves, the average knowledge score in 2020 for people having never been targeted to receive a DAI *document is however higher than that of people having been targeted to receive exactly one* DAI *document.*

Figure I – **Distribution of respondents according to the degree to which they are aware of their entitlements**



Reading note: In 2020, 27.7% of all respondents have a knowledge score of two out of three, and 30.6% of the respondents included in both waves have this score.
Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents.

Figure II – **Mean level of knowledge of entitlements by number of DAI documents sent**



Notes: * Indicates that the difference compared to the reference (no DAI sent) is significant at the 10% level, ** at the 5% level, *** at the 1% level.
Reading note: In 2020, the mean knowledge score of respondents who were sent at least three DAI documents was 1.77 (left-hand graph), which differs significantly at the 1% level of the mean score of 1.11 observed for those who had not been sent any documents.
Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents.

on the whole (Figure II). It increases with age, and is lower among women than men (see Table A2-1 of Appendix 2 for the detailed descriptive statistics). Income level also seems to play a discriminating role with, in 2020, a gap of 0.8 between the average knowledge score of people with a net annual income of at least €30,000 and those earning less than €12,000. We also see that people who are not retired and not working seem to be less informed of their pension entitlements (probably because they have acquired fewer entitlements) than those in employment, especially in comparison with civil servants, who seem to be the best informed. People who have had breaks in their careers or those who lack financial foresight have a lower level of knowledge.

Between 2012 and 2020, the average score for knowledge of personal entitlements increased by 0.5 points for all non-retired respondents (and for those individuals common to both waves). The improvement can be seen across all three of the questions that comprise the score: number of quarters already accrued, age of entitlement (depending on year of birth) and, to a lesser extent, the length of insurance required to access a full pension (also depending on year of birth). The increase in the average knowledge level between 2012 and 2020 can be seen across all age ranges: it is more marked for those aged under 49 (+0.5 points) than for those aged 50 and over (+0.3 points); this result should be compared against the fact that the knowledge score for those aged 50 and above was, on average, considerably higher than that of the younger group in 2012. The improvement is also greater for women, civil servants, people with dependent children and people in good health. It is also greater for people on middle and higher incomes (above €12,000), but also for people not targeted to receive DAI documents, a sign that the improvement in knowledge of personal entitlements between the two waves is definitely not attributable solely to the DAI.

2.2. Respondents with Good Knowledge of their Personal Entitlements Are Less Concerned about their Entitlements

The score for concern regarding personal pension entitlements is based on four questions, each scored from 0 to 2, with 0 corresponding to confidence in pension entitlements and

Box 2 – **Questions asked for the construction of the knowledge and concern scores**

The coding and values taken by each of the questions making up the scores in both 2012 and 2020 are described in detail in Arrondel *et al.* (2013 and 2021).

The knowledge score for personal pension entitlements is calculated on the basis of three questions:

(i) "Do you know how many quarters or years you have accrued to date or that you will have accrued at the time of your retirement?" This is a declarative question with the option of responding either "yes" or "no". The question is supplemented by an additional question as to the number of quarters or years already credited, which allows a consistency check to be carried out between the response given and the theoretical age of entry onto the labour market if the person has not experienced any breaks in their career.

(ii) "How many quarters do you think you need or needed to accrue (in total) in order to receive the full-rate pension entitlement?"

(iii) "What is the minimum age at which you could or were able to retire?"

Each correct response is assigned a value of 1, each incorrect response equals 0. The score is the total points.

The concern score for personal pension entitlements is calculated based on four questions, each scored from 0 to 2, with 0 corresponding to greater confidence in pension entitlements and 2 to concern; 1 represents an intermediate or neutral position:

(i) "Which of the following best describes your view of your financial situation during your retirement? I will be able to or I am able to enjoy my retirement without having to worry about money (score of 0); I will need to or I need to keep an eye on my outgoings, but I will be able to or I am able to live comfortably (score of 0); I have not thought about it, but I am confident (score of 0); I will have or I have difficulty making ends meet (score of +2); I will have or I have real money worries (score of +2); I have not thought about it, but I am concerned (score of +2); I do not know (score of +1)."

(ii) "All being well, do you think that your retirement pension will be sufficient (or is sufficient if you are already retired) to meet your needs? yes (score of 0); no, it will not quite be enough (it is not quite enough) (score of +1); no it will be (is) far too low (score of +2); I do not know (score of +1)."

(iii) "When you retire or if you are already retired, do you think you will be able to afford accommodation in a retirement home with your personal pension? yes (score of 0); no (score of +2); I do not know (score of +1)."

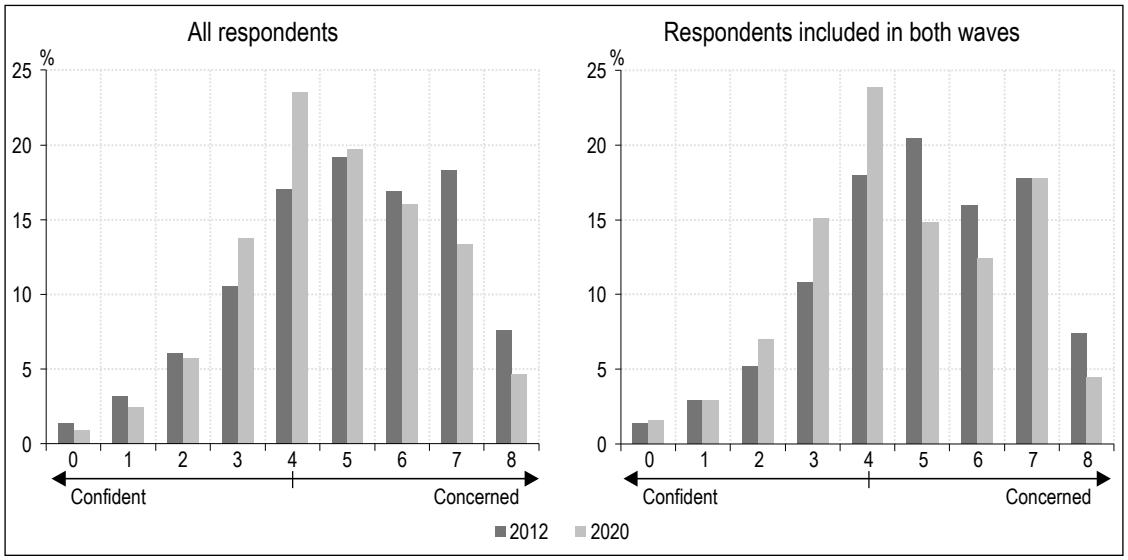
(iv) "In your opinion, by the time you retire, what is the probability, from 0 to 100, that the amount of your pension will be lower than the pension received by somebody with the same career as you retiring today (from 0 to 30 score of 0, from 31 to 69 score of +1 and between 70 and 100 score of +2)?"

The concern score is the sum of the scores for the four questions.

2 to concern; 1 represents an intermediate or neutral feeling. The concern score is the sum of the scores for the four questions, meaning that it can vary between 0 and 8. It measures both the respondent's fear of not having a sufficient pension and their uncertainty regarding the amount of their future pension, or, in other words, the level of ambiguity surrounding their future pension. If we consider that an individual is concerned about their pension entitlements once their concern score is strictly above 4, then in 2020, 53.7% of non-retired respondents stated that they were concerned (Figure III).

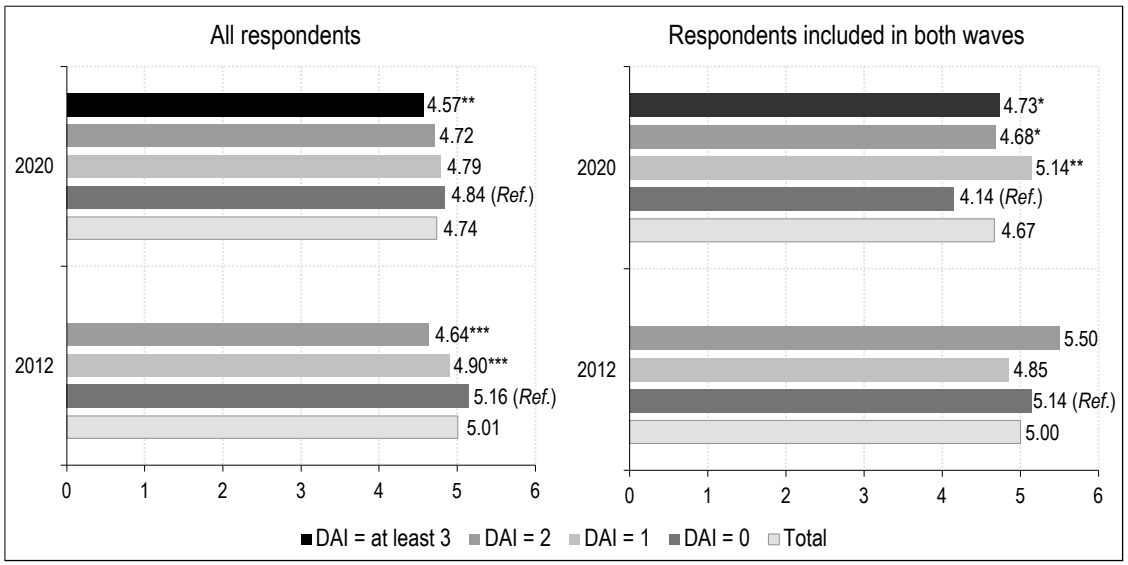
Overall, people who have specifically been targeted to be sent one or more DAI documents have more confidence (Figure IV), both in 2012 and 2020, even if the differences between the average concern scores based on the number of documents sent are not always significant. Respondents who have good or very good knowledge of their personal pension entitlements have more confidence (see Table A2-2 in Appendix 2 for detailed descriptive statistics). Concern falls from aged 50 onwards, probably due to increased knowledge of the entitlements acquired over time, and a reduction in the risk of

Figure III – **Distribution of respondents by level of concern with regard to their entitlements**



Reading note: In 2020, 19.7% of all respondents had a concern score of five out of eight, and 14.9% of respondents to both waves had this score.
Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents.

Figure IV – **Mean level of concern with regard to entitlements according to the number of DAI documents sent**



Notes: * Indicates that the difference compared to the reference (no DAI sent) is significant at the 10% level, ** at the 5% level, *** at the 1% level.
Reading note: In 2020, the mean concern score of respondents who were sent at least three DAI documents was 4.57, which differs significantly at the 5% level of the mean score of 4.84 observed for those who had not been sent any documents.
Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents.

being affected by different, less beneficial rules as retirement approaches. Men are less concerned than women. The higher the income, the lower the concern about entitlements. Concern is, on average, lower for civil servants, those with higher education qualifications, people who are less risk-averse, those with financial foresight,[6] married people, people without dependent children, people in good health, and people with regular careers without breaks.

Between 2012 and 2020, concern regarding personal pension entitlements fell on average by 0.3 points. The reduction is greater for women, for younger people (under 50), for those with middle incomes (between €12,000 and 20,000), for those with financial foresight and for those who are risk-averse, for people who have good or very good knowledge of their own entitlements, for people who had not been sent any DAI documents or for those who have had regular careers without interruption.

3. Levels of and Changes in Knowledge and Concern Regarding their Personal Entitlements

3.1. The First DAI Documents Sent Have an Impact on Knowledge of Entitlements but their Impact on Concern with Regard to Entitlements Is Uncertain

We will now attempt to assess the impact of sending DAI information (DAI_{it}) to respondent i in year t (t=2012 or t=2020) on the level of knowledge of their personal entitlements (Y_{it1}) and on the level of concern regarding their personal entitlements (Y_{it2}), by controlling individual characteristics (X_{it}):

$$Y_{it} = \alpha + \beta DAI_{it} + \gamma X_{it} + \varepsilon_{it}$$

We are not taking into consideration the panel dimension of the data, and are simply collating the data from the two waves. The analysis focuses on respondents who were not retired in 2012 or in 2020.

Several specifications were tested:

(1) with only the theoretical number of DAI documents sent (this variable, between 0 and 4, with linear relationship), the year and age groups (under 35, 35-49 and 50 and over) as the baseline estimate;

(2) by adding control variables to baseline estimate (1): gender, professional status (public sector, private sector, self-employed, not working), net income groups, completion of higher education, preference parameters (risk aversion and financial foresight), family situation (couple, dependent children), health status and career irregularities and breaks;

(3) specification (2) but discretising the theoretical number of DAI documents sent into four groups to identify any non-linearities;

(4) specification (3) but replacing age groups with a quadratic function of age as a continuous variable;

(5) specification identical to (2) for the level of concern but adding the score for knowledge of pension entitlements in order to see whether a lower concern score is due more to the provision of DAI information or if respondents with better knowledge of their pension entitlements are less concerned about their future pension.[7]

The variables explained are discrete variables. However, we have preferred linear estimates rather than ordered logit estimates in order to make it easier to make comparisons with the estimate presented in the sub-section below. The main results are given in Table 1 and those relating to the control variables are given in Table A3-1 of Appendix 3.

Overall, the number of DAI documents sent does not seem to have a significant impact on the level of knowledge of personal entitlements once the survey context is taken into consideration, using a response year indicator – estimates (1) and (2). Conversely, if we examine possible non-linearities, the impact of the DAI documents on the knowledge score is significant for the first document sent, but not when several are sent – estimates (3) and (4). With given characteristics, and once the number of DAI documents potentially received has been taken into account, the respondents' level of knowledge of their pension entitlements is significantly higher in 2020 than in 2012.

In a relatively logical way, the level of knowledge increases with age, from the age of 31, improving as the respondent approaches the date on which they will receive those pension entitlements. The greater knowledge possessed by the older age group (50 and over) is undoubtedly

6. Risk aversion and financial foresight are measured on a scale from 0 to 10 in each survey wave. For example, for risk aversion, the following question is asked: "on a scale from 0–10, do you generally consider yourself to be a cautious person who keeps risks to a minimum or, conversely, someone who likes taking risks, who likes adventure and seeks new things and challenges? 0 represents a very cautious person, 10 a person who likes to take risks.

7. The inverse correlation between good knowledge of personal pension entitlements (score ≥ 2) and concern regarding those entitlements (score > 4) was also tested using a bivariate probit model. However, so as not to overburden this article, the results are not given here but can be provided by the authors on request.

Table 1 – **Estimated knowledge and concern scores for personal entitlements**

	Knowledge score for personal entitlements				Concern score for personal entitlements				
	Base	With control variables	DAI in brackets	Age (continuous)	Base	With control variables	DAI in brackets	Age (continuous)	With knowledge of entitlements
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(5)
Number of DAI	0.016	0.006	-	-	−0.002	−0.006	-	-	−0.005
	(0.030)	(0.029)			(0.054)	(0.050)			(0.050)
Discretised DAI (*Ref.: No DAI sent*)									
1 DAI sent	-	-	0.094*	0.120**	-	-	−0.044	−0.012	-
			(0.054)	(0.049)			(0.107)	(0.095)	
2 DAI sent	-	-	0.021	−0.064	-	-	−0.017	0.097	-
			(0.066)	(0.066)			(0.121)	(0.118)	
At least 3 DAI sent	-	-	0.060	−0.123	-	-	−0.025	0.175	-
			(0.093)	(0.095)			(0.162)	(0.162)	
Response in 2020	0.358***	0.306***	0.327***	0.360***	−0.249***	−0.059	−0.070	−0.099	−0.025
(*Ref.: Response in 2012*)	(0.039)	(0.038)	(0.039)	(0.039)	(0.070)	(0.066)	(0.068)	(0.069)	(0.067)
Age in brackets (*Ref.: 50 and over*)									
Under 35	−0.723***	−0.661***	−0.620***	-	0.344***	0.299**	0.283**	-	0.225*
	(0.064)	(0.063)	(0.067)		(0.124)	(0.120)	(0.132)		(0.121)
35-49 years	−0.384***	−0.438***	−0.440***	-	0.329***	0.440***	0.443***	-	0.391***
	(0.043)	(0.043)	(0.043)		(0.078)	(0.079)	(0.079)		(0.080)
Age (continuous)									
Age	-	-	-	−0.065***	-	-	-	0.109***	-
				(0.011)				(0.023)	
Age²	-	-	-	0.00104***	-	-	-	−0.00145***	-
				(0.0001)				(0.0003)	
Knowledge score for personal entitlements	-	-	-	-	-	-	-	-	−0.112***
									(0.029)
Gender (*Ref.: Male*)									
Female	-	−0.117***	−0.116***	−0.121***	-	0.246***	0.245***	0.247***	0.232***
		(0.032)	(0.032)	(0.032)		(0.060)	(0.060)	(0.060)	(0.060)
Control variables[(a)]	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Constant	1.363***	1.156***	1.102***	1.418***	4.786***	4.822***	4.845***	3.303***	4.951***
	(0.052)	(0.078)	(0.083)	(0.227)	(0.096)	(0.141)	(0.155)	(0.458)	(0.143)
Adjusted R^2	0.118	0.208	0.208	0.225	0.012	0.158	0.158	0.162	0.161
Statistical F	130.9***	52.1***	47.6***	52.3***	13.3***	37.6***	34.2***	35.3***	36.6***

[(a)] Status, income, educational level, preferences, marital status, health status, career irregularities.
Notes: Estimate of a linear model using the ordinary least squares method. Standard errors are in parentheses. * indicates that the coefficient is significant at the 10% level; ** at the 5% level; *** at the 1% level.
Source and coverage: PAT€R surveys 2012 and 2020. Excluding retired people, i.e. 3,895 observations.

reinforced by the fact that we have made no distinction between the sending of individual pension entitlement statements before the age of 55 and the sending of overall indicative estimates, which are more detailed, after the age of 55.

With all other characteristics being the same, employees in the public sector have greater knowledge of their personal pension entitlements than those working in the private sector and the self-employed. Those who are not working (but are not retired), and who probably have fewer entitlements, have an even more limited knowledge. The knowledge score is positively correlated to income level, completion of higher education and good health. It is significantly lower for women, single people (although not significant for all specifications), and those with dependent children (maybe due to poor knowledge of increases in pension and length of insurance linked to children). People with irregular careers also seem to be less informed of their entitlements. Finally, those who lack financial foresight also have a lower knowledge score.

The theoretical number of DAI documents sent does not have a significant effect on the level of concern regarding personal entitlements, whether we consider the effect to be

proportional to the number of documents sent or to be potentially different for each number of documents sent. The specificity of the survey context does not significantly influence the level of concern once the particular characteristics of the respondents are taken into consideration, i.e. once the respondent structural effects have been controlled. Conversely, the level of concern regarding future pensions is negatively correlated to the level of knowledge of pension entitlements − estimate (5).

The level of concern is highest at intermediate ages and lowest among older people as they approach retirement age, with a peak at around the age of 38 − estimate (4). Concern seems to be significantly lower among public sector employees.

Concern regarding personal pension entitlements is partly linked to expectations of the future pension level from contributory schemes. For example, people with a lower annual income (less than €12,000) have a higher level of concern regarding their future pension than people with an intermediate income (between €12,000 and €20,000), and those with a higher annual income (above €20,000) have a lower level of concern regarding their future pension. With given characteristics and, in particular, a given income level, people who have completed higher education have a lower level of concern than others, which may be linked to a greater capacity to plan for their future retirement. In terms of preferences, people with greater financial foresight and those who are more averse to risk are more concerned about their personal pension entitlements. People who have had a more bumpy career or breaks in their careers due to unemployment also have higher levels of concern. Finally, with all other characteristics the same, women, people with dependent children and those living alone are more concerned about their future pension than men, people without dependent children and those who live in a couple. In other words, people who have experienced less favourable job-market situations or more difficult life situations tend to be more concerned.

Therefore, overall, the sending of information on pension entitlements and the different survey context seem to directly improve the knowledge of French people, while concern regarding future pension reduces for people as they approach retirement (those aged 50 and over). The magnitude of the effects on the level of knowledge remains low (around 0.1 point for the first DAI document sent).

3.2. Change in Knowledge and Concern Regarding Personal Entitlements

We will now analyse the extent to which the changes in individual characteristics between 2012 and 2020 can be correlated to the change in knowledge or concern between the two waves, using the panel dimension of the survey. Regressions are established based solely on the individuals common to both waves, and pensioners continue to be excluded. We have estimated the following linear model:[8]

$$Y_{i,t} = \alpha_i + \beta DAI_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t}$$

This gives in first difference:

$$Y_{i,2020} - Y_{i,2012} = (\alpha_i - \alpha_i) + \beta\left(DAI_{i,2020} - DAI_{i,2012}\right) + \gamma\left(X_{i,2020} - X_{i,2012}\right) + \left(\varepsilon_{i,2020} - \varepsilon_{i,2012}\right)$$

either, $\Delta Y_{i,t} = \beta \Delta DAI_{i,t} + \gamma \Delta X_{i,t} + \Delta\varepsilon_{i,t}$

where Δ is the operator difference between 2012 and 2020, $DAI_{i,t}$ the number of DAI documents sent before date t to individual i, and $X_{i,t}$ the individual characteristics of i on t. Lastly, $Y_{i,t}$ is, successively, knowledge of personal pension entitlements (the results of the regressions are given in Table 2 and Table A3-2 of Appendix 3 for the control variables) and concern regarding personal pension entitlements (the results are given in Table 3 and in Table A3-3 of Appendix 3 for the control variables) for individual i on t. This estimate in first difference makes it possible to control for all the individual characteristics of i constant over time (α_i).

Several alternative specifications were tested; these were identical to those given in Section 3.1, but in first difference.

For the respondents included in both waves, even more so than for all respondents, the improvement in knowledge between 2012 and 2020 seems, above all, to be the result of the differences in the context of the survey waves rather than of the increase in DAI documentation. The sending of additional DAI documents between 2012 and 2020 seems, instead, to have had a downward effect on the level of knowledge between the two waves, all other things being equal – estimates (1) and (2) in Table 2. This marginally significant negative effect can be seen if we consider the effect of the DAI information to be potentially different for each additional document sent − estimate (3). This result, which is somewhat different from that obtained for

*8. The variables explained are discrete ordered variables. Panel ordered logit regressions with fixed effects (*Baetschmann et al.*, 2020) have therefore been created and the results are substantially similar. While these estimates are* a priori *more appropriate, the effects are less directly clear. As a result, they are also not given here.*

Table 2 – **Estimated change in the knowledge score for personal entitlements between 2012 and 2020**

	Base	With control variables	DAI in brackets
	(1)	(2)	(3)
Number of DAI	−0.144* (0.083)	−0.124 (0.088)	-
Discretised DAI (*Ref.: No DAI sent*)			
1 DAI sent	-	-	−0.220* (0.128)
2 DAI sent	-	-	−0.243 (0.200)
At least 3 DAI sent	-	-	−0.332 (0.272)
Age (*Ref.: 50 and over*)			
Under 35	0.343 (0.218)	0.308 (0.214)	0.220 (0.247)
35-49 years	0.240** (0.120)	0.240** (0.121)	0.270** (0.124)
Control variables[(a)]	No	Yes	Yes
Response in 2020	0.783*** (0.134)	0.738*** (0.145)	0.680*** (0.177)
Adjusted R^2	0.012	0.022	0.020
Statistical F	2.8**	1.7*	1.6*

[(a)] Status, income, educational level, preferences, marital status, health status, career irregularities.
Notes: Estimate of a linear, first-difference model. The regressions are run with R using the "plm" procedure, the "fd" (first difference) model specification and a correction of the variance of the residuals with the Arellano method. Robust standard errors are in parentheses. * indicates that the coefficient is significant at the 10% level; ** at the 5% level; *** at the 1% level.
Source and coverage: PATER surveys 2012 and 2020. Respondents common to the two waves, excluding retired people, i.e. 444 observations.

Table 3 – **Estimated change in the concern score for personal entitlements between 2012 and 2020**

	Base	With control variables	DAI in brackets	With knowledge
	(1)	(2)	(3)	(4)
ΔDAI	0.040 (0.132)	0.030 (0.134)		0.011 (0.132)
Discretised DAI *(Ref.: No DAI sent)*				
1 DAI sent	-	-	−0.089 (0.222)	-
2 DAI sent	-	-	0.063 (0.284)	-
At least 3 DAI sent	-	-	0.142 (0.414)	-
Age *(Ref.: 50 and over*)				
Under 35	−0.400 (0.371)	−0.410 (0.382)	−0.518 (0.417)	−0.361 (0.387)
35-49 years	−0.052 (0.206)	−0.019 (0.206)	0.019 (0.212)	0.019 (0.210)
Knowledge score for personal entitlements				−0.160* (0.093)
Control variables [(a)]	No	Yes	Yes	Yes
Constant	−0.448** (0.201)	−0.456** (0.221)	−0.527** (0.244)	−0.338 (0.226)
Adjusted R^2	−0.003	0.005	0.001	0.011
Statistical F	0.6	1.1	1.0	1.3

[(a)] Status, income, educational level, preferences, marital status, health status, career irregularities.
Notes: Estimate of a linear, first-difference model. The regressions are run with R using the "plm" procedure, the "fd" (first difference) model specification and a correction of the variance of the residuals with the Arellano method. Robust standard errors are in parentheses. * indicates that the coefficient is significant at the 10% level; ** at the 5% level; *** at the 1% level.
Source and coverage: PATER surveys 2012 and 2020. Respondents common to the two waves, excluding retired people, i.e. 444 observations.

the complete sample for the two surveys, is potentially linked to the specifics of the sample included in both waves (see Table A1-1 in the Appendix). This result is consistent with the fact that it is the generations who reached the age of 35 between 2012 and 2020 (age at which the first document is sent) who experienced the greatest increase in knowledge regarding their entitlements between the two waves.

In terms of concern regarding personal entitlements, the additional sending of DAI documents between 2012 and 2020 has no significant impact on the change in concern regarding personal entitlements, in any specification (see Table 3). With other given individual characteristics, the fall in concern seems to be a result of the differences in context between the two survey waves. This trend can be seen in the results of the survey "*Les Français, l'épargne et la retraite*" [The French, savings and pensions] carried out for the association *Cercle des Épargnants*: in 2021, 60% of people surveyed stated that they were concerned,[9] compared with 73% in 2018, this proportion having fallen steadily. This survey also shows this reduction across all age groups.

9. For more details, see: https://www.cercledesepargnants.com/wp-content/uploads/2021/02/Barometre2021VFLes-Franc%CC%A7ais-e%CC%81pargne-et-retraiteCercledesEpargnants-Diffusion.pdf.

Finally, the respondents whose knowledge of personal entitlements improved between 2012 and 2020 also show a reduction in concern regarding their personal entitlements over the same period: their concern score fell by around 0.16 points for every one-point increase in their entitlement knowledge score − estimate (4). The potential inverse effect of increased knowledge of pension entitlements on confidence in terms of future pension can be interpreted as a reduction in the ambiguity regarding respondents' expectations of their future pension amount. This leads us to think that the provision of information associated with the DAI, in particular the first document sent, and the context, specifically public debates on pensions, directly improve individuals' knowledge of their pension entitlements and indirectly reduce concerns regarding the future amount of that pension.

We can see that the low significance of certain coefficients of estimates in first difference and the overall lack of significance of concern estimates are primarily the result of the small size of the sample of respondents included in both waves. The use of a bootstrap method to increase the sample by means of a random draw with replacement would have made it possible to reduce these limitations. The significance of the effects of the provision of information on knowledge (direct) and concern (indirect) is weak, depending on the specifications, the scopes of the population surveyed and the survey context of those surveyed, which is consistent with the results of numerous studies in the area of Financial Literacy. We can, however, consider that the people who are best informed about their entitlements will have better expectations regarding their future pension and that they will adjust their retirement age and level of savings if they expect a reduction in their replacement rate (Arrondel *et al*., 2020; 2023).

* *
*

We can see that the higher the number of DAI documents sent to individuals, the higher their score for knowledge of personal pension entitlements. We can also see that, on average, knowledge of pension entitlements increased between 2012 and 2020, while concern regarding future pension amounts fell over the same period.

The econometric analysis makes it possible to distinguish between the effects of age, sending of DAI documents, and the specific contexts of the years 2012 and 2020 on the level of knowledge. We show that only the first documents sent as part of the DAI seem to improve knowledge of personal pension entitlements. We also show that knowledge is, for the most part, linked to age and context: all things being equal, older people have better knowledge of their entitlements, and knowledge is better in 2020 than in 2012. Lastly, the improvement in knowledge of entitlements between 2012 and 2020 seems to have indirectly fostered the reduction in concern regarding future pension entitlements by reducing the ambiguity regarding future pensions.

However, with only two survey waves, it is not possible to identify with certainty the different factors likely to explain the differences in context: consequences of the debate in late 2019 and reform bill in early 2020 seeking to introduce a universal pension system; less confusion in 2020 than in 2012 between the two mechanisms for increasing the retirement age (extending the length of insurance and raising the age at which people are entitled to pension benefits); regular reports and reforms on pension issues that took place between 2012 and 2020; shift towards other causes of concern due to the health crisis, etc. □

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APPENDIX 1

STATISTICS ON RESPONDENTS FROM THE 2012 AND 2020 WAVES OF THE PAT€R SURVEY

Table A1-1 – **Characteristics of respondents to the 2012 and 2020 PAT€R surveys**

		PAT€R 2012		PAT€R 2020	
		Total	Included in both waves	Total	Included in both waves
Number of respondents		1,835	444	2,060	444
Gender	Proportion of women (%)	52.4	52.5	52.5	52.5
Age	Mean age	42.4	41.8	44.1	49.5
	Proportion aged under 35 (%)	28.6	22.7	26.3	9.9
	Proportion aged 35-49 (%)	37.3	52.0	35.4	35.8
	Proportion aged 50 and over (%)	34.1	25.2	38.3	54.3
Status	Proportion of employees (%)	61.4	59.5	60.2	60.6
	Proportion of civil servants (%)	20.8	25.5	22.0	28.2
	Proportion of self-employed (%)	7.2	5.4	6.7	8.1
	Proportion of jobseekers and non-workers (excluding pensioners) (%)	10.5	9.7	11.0	3.2
Income	Proportion earning under €12,000 (%)	28.5	22.5	23.7	20.5
	Proportion earning €12,000-19,999 (%)	28.1	31.1	24.4	25.5
	Proportion earning €20,000-29,999 (%)	23.5	27.5	26.2	30.0
	Proportion earning €30,000 and over (%)	14.2	12.2	22.2	20.5
	Proportion of non-responses (%)	5.6	6.8	3.4	3.6
Studies	Proportion of individuals having completed higher education (%)	44.5	43.2	52.8	43.0
Preferences	Proportion of individuals willing to take risks (%)	9.8	7.0	17.1	13.3
	Proportion of individuals who lack foresight (%)	11.4	11.7	10.5	9.7
In a couple	Proportion of individuals who are married, cohabiting, in a civil partnership (%)	64.1	61.5	59.5	65.8
Children	Proportion of individuals with at least one dependent child (%)	45.0	52.7	43.7	47.7
Health	Proportion of individuals in good health (%)	88.4	89.6	90.3	89.0
Career	Proportion of individuals who have had an irregular career (%)	26.9	23.4	18.5	20.7
	Proportion of individuals whose careers have been interrupted by unemployment (%)	53.4	55.2	49.6	53.8
	Proportion of individuals who have experienced other career interruptions (%)	28.8	25.5	30.9	34.0
Theoretical sending of DAI	Proportion of individuals sent one DAI (DAI=1) (%)	45.9	49.5	11.0	8.1
	Proportion of individuals sent two DAI (DAI=2) (%)	6.4	0.9	46.7	61.7
	Proportion of individuals sent at least three DAI (DAI=3+) (%)	0.0	0.0	14.3	19.1

Reading note: 28.6% of non-pensioners interviewed in 2012 were under 35, compared with 26.3% of those interviewed in 2020. Among those interviewed in both waves, 22.7% were under 35 in 2012, compared with 9.9% in 2020.
Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents.

APPENDIX 2

DESCRIPTIVE STATISTICS FOR KNOWLEDGE AND CONCERN

Table A2-1 – **Mean knowledge scores for personal entitlements**

		PAT€R 2012		PAT€R 2020	
		Total	Included in both waves	Total	Included in both waves
Total		1.02	1.17	1.50	1.63
Gender	Female (*Ref.*)	0.91	0.84	1.33	1.40
	Men	1.14***	1.22***	1.52***	1.65***
Age	Under 35 (*Ref.*)	0.57	0.56	1.07	1.30
	35-49	0.93***	1.03***	1.42***	1.31
	50 and over	1.50***	1.40***	1.66***	1.70**
Status	Employees (*Ref.*)	1.05	1.03	1.33	1.39
	Civil servants	1.25***	1.23*	1.94***	1.9***
	Self-employed	1.08	1.33	1.28	1.44
	Jobseekers and non-workers (excluding pensioners)	0.36***	0.21***	0.96***	0.86*
Income	Less than €12,000	0.73***	0.65***	0.94***	0.96***
	€12,000-19,999 (*Ref.*)	1.02	1.04	1.38	1.47
	€20,000-29,999	1.22***	1.27**	1.68***	1.83***
	€30,000 and above	1.43***	1.31*	1.78***	1.79**
	Non-response (difference not tested)	0.70	0.60	0.67	0.94
Studies	No higher education (*Ref.*)	1.00	0.96	1.29	1.47
	Higher education	1.05	1.10	1.53***	1.59
Preferences	Risk averse (*Ref.*)	1.02	1.03	1.42	1.52
	Risk taker	1.07	0.84	1.40	1.51
	Persons with foresight (*Ref.*)	1.05	1.05	1.45	1.56
	Persons without foresight	0.82***	0.75**	1.17***	1.19**
Marital status	Single, divorced, widowed (*Ref.*)	0.97	0.99	1.37	1.51
	Married, cohabiting, in a civil partnership	1.05*	1.04	1.45*	1.52
Children	No dependent children (*Ref.*)	1.11	1.09	1.44	1.60
	Dependent children	0.91***	0.95	1.39	1.43*
Health	In poor health (*Ref.*)	0.97	1.09	0.99	0.96
	In good health	1.03	1.01	1.46***	1.59***
Career	Without irregular career (*Ref.*)	1.06	1.08	1.50	1.65
	With irregular career	0.93**	0.82**	1.07***	1.03***
	Without breaks due to unemployment (*Ref.*)	1.03	0.95	1.48	1.66
	With breaks due to unemployment	1.02	1.07	1.35***	1.4***
	Without other breaks (*Ref.*)	1.03	1.06	1.50	1.70
	With other breaks	1.00	0.89	1.23***	1.17***

Notes: The average score for individuals sharing a characteristic is compared to the average score of individuals with the reference characteristic and belonging to the same field on the same date. *** indicates that the difference between the two mean scores is significant at the 1% level, ** at the 5% level, * at the 10% level.
Reading note: Non-retired respondents have a mean knowledge score for their pension entitlements of 1.02 in 2012 and 1.50 in 2020.
Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents.

Table A2-2 – **Mean concern scores for personal entitlements**

		PAT€R 2012		PAT€R 2020	
		Total	Included in both waves	Total	Included in both waves
Total		5.01	4.88	4.62	4.52
Gender	Female (*Ref.*)	5.23	5.21	4.94	4.86
	Men	4.76***	4.78**	4.52***	4.46**
Age	Under 35 (*Ref.*)	5.16	4.83	4.85	4.11
	35-49	5.12	5.15	4.85	5.00***
	50 and over	4.75***	4.86	4.56***	4.55
Status	Employees (*Ref.*)	5.10	5.19	4.79	4.80
	Civil servants	4.58***	4.58***	4.36***	4.26***
	Self-employed	5.15	4.88	4.94	4.94
	Jobseekers and non-workers (excluding pensioners)	5.21	5.07	5.07**	5.21
Income	Less than €12,000	5.56	5.65	5.44***	5.73***
	€12,000-19,999 (*Ref.*)	5.48	5.38	5.03	4.73
	€20,000-29,999	4.58***	4.70***	4.55***	4.36**
	€30,000 and above	3.78***	3.76***	3.87***	3.92***
	Non-responses (difference not tested)	4.72	4.53	4.93	5.06
Studies	No higher education (*Ref.*)	5.24	5.24	5.00	4.87
	Higher education	4.72***	4.69***	4.51***	4.40***
Preferences	Risk averse (*Ref.*)	5.04	5.01	4.77	4.69
	Risk taker	4.72*	4.90	4.61	4.53
	Persons with foresight (*Ref.*)	4.94	4.96	4.66	4.56
	Persons without foresight	5.56***	5.31	5.39***	5.7***
Marital status	Single, divorced, widowed (*Ref.*)	5.08	4.98	4.85	4.73
	Married, cohabiting, in a civil partnership	4.96	5.02	4.67**	4.64
Children	No dependent children (*Ref.*)	4.92	4.89	4.67	4.54
	Dependent children	5.11**	5.10	4.83**	4.81
Health	In poor health (*Ref.*)	5.32	5.43	5.24	5.41
	In good health	4.96***	4.95*	4.69***	4.58***
Career	Without irregular career (*Ref.*)	4.79	4.80	4.55	4.38
	With irregular career	5.6***	5.66***	5.57***	5.77***
	Without breaks due to unemployment (*Ref.*)	4.66	4.67	4.44	4.22
	With breaks due to unemployment	5.30***	5.27***	5.05***	5.05***
	Without other breaks (*Ref.*)	4.90	4.91	4.56	4.51
	With other breaks	5.27***	5.27*	5.14***	4.98**
Knowledge of their entitlements	Poor knowledge (score < 2) (*Ref.*)	5.15	5.17	5.07	5.13
	Good knowledge (score ≥ 2)	4.69***	4.65***	4.36***	4.25***

Notes: The average score for individuals sharing a characteristic is compared to the average score of individuals with the reference characteristic and belonging to the same field on the same date. *** indicates that the difference between the two mean scores is significant at the 1% level, ** at the 5% level, * at the 10% level.
Reading note: Non-retired respondents have a mean concern score for their personal pension entitlements of 5.01 in 2012 and 4.62 in 2020.
Source and coverage: PAT€R-2012 and PAT€R-2020. Non-retired respondents in the 2012 and 2020 waves.

APPENDIX 3

COMPLEMENTARY RESULTS OF REGRESSIONS FOR THE CONTROL VARIABLES

Table A3-1 – **Estimated knowledge and concern scores for personal entitlements**

	Knowledge score for personal entitlements			Concern score for personal entitlements			
	With control variables	DAI in brackets	Age (continuous)	With control variables	DAI in brackets	Age (continuous)	With knowledge
	(2)	(3)	(4)	(2)	(3)	(4)	(5)
Status (Ref.: Private status)							
Public	0.275***	0.277***	0.288***	−0.162**	−0.163**	−0.176**	−0.132*
	(0.040)	(0.040)	(0.039)	(0.078)	(0.078)	(0.078)	(0.079)
Self-employed	−0.011	−0.010	−0.034	0.069	0.068	0.092	0.068
	(0.067)	(0.067)	(0.066)	(0.113)	(0.113)	(0.113)	(0.113)
Jobseekers and non-workers	−0.180***	−0.181***	−0.268***	−0.023	−0.024	0.149	−0.044
	(0.056)	(0.056)	(0.060)	(0.099)	(0.099)	(0.111)	(0.100)
Net annual income (*Ref.: €12,000-19,999 or not specified*)							
< €12,000	−0.151***	−0.152***	−0.168***	0.186**	0.186**	0.204***	0.169**
	(0.042)	(0.042)	(0.041)	(0.072)	(0.072)	(0.072)	(0.072)
€20,000-29,999	0.176***	0.175***	0.189***	−0.425***	−0.425***	−0.450***	−0.405***
	(0.044)	(0.044)	(0.044)	(0.077)	(0.077)	(0.077)	(0.077)
€30,000 and above	0.283***	0.282***	0.286***	−1.038***	−1.037***	−1.053***	−1.006***
	(0.049)	(0.049)	(0.049)	(0.094)	(0.094)	(0.094)	(0.094)
Has completed higher education	0.126***	0.127***	0.144***	−0.200***	−0.201***	−0.208***	−0.186***
	(0.034)	(0.034)	(0.034)	(0.064)	(0.064)	(0.064)	(0.064)
Risk-taker	0.026	0.027	0.023	−0.154*	−0.154*	−0.145*	−0.151*
	(0.043)	(0.043)	(0.043)	(0.081)	(0.081)	(0.081)	(0.081)
Person without foresight	−0.087*	−0.085*	−0.083*	0.388***	0.388***	0.393***	0.378***
	(0.047)	(0.047)	(0.046)	(0.088)	(0.088)	(0.088)	(0.087)
In a couple	0.063*	0.061*	0.055	−0.146**	−0.145**	−0.160**	−0.139**
	(0.036)	(0.036)	(0.036)	(0.062)	(0.062)	(0.063)	(0.062)
Has dependent children	−0.131***	−0.129***	−0.057	0.185***	0.184***	0.129*	0.170***
	(0.037)	(0.037)	(0.037)	(0.066)	(0.066)	(0.067)	(0.066)
Is in good health	0.238***	0.238***	0.255***	−0.182**	−0.182**	−0.196**	−0.155*
	(0.049)	(0.049)	(0.049)	(0.088)	(0.088)	(0.088)	(0.089)
Irregular career	−0.124***	−0.124***	−0.112***	0.461***	0.461***	0.442***	0.447***
	(0.040)	(0.040)	(0.040)	(0.072)	(0.072)	(0.072)	(0.072)
Has experienced breaks in career due to unemployment							
	0.012	0.014	0.025	0.286***	0.285***	0.263***	0.287***
	(0.034)	(0.034)	(0.034)	(0.062)	(0.062)	(0.062)	(0.062)
Has experienced breaks in career for other reasons							
	−0.044	−0.043	−0.060	−0.035	−0.035	−0.024	−0.040
	(0.038)	(0.038)	(0.038)	(0.067)	(0.067)	(0.067)	(0.067)

Notes: Estimate of a linear model using the ordinary least squares method. The standard errors are in parentheses. * indicates that the coefficient is significant at the 10% level; ** at the 5% level; *** at the 1% level.
Source and coverage: PAT€R surveys 2012 and 2020. Excluding retired people, i.e. 3,895 observations.

Table A3-2 – **Estimated change in the knowledge score for personal entitlements**

	Without age (1)		Without constant (2)		DAI in brackets (3)	
Ref.: Net annual income: €12,000-19,999 and income not specified						
Net annual income: < €12,000	−0.116	(0.120)	−0.098	(0.126)	−0.182	(0.133)
Net annual income: €20,000-29,999	0.069	(0.119)	0.111	(0.120)	0.153	(0.120)
Net annual income: €30,000 and above	0.029	(0.174)	0.074	(0.176)	0.091	(0.175)
Risk-taker	−0.148	(0.130)	−0.099	(0.137)	−0.132	(0.137)
Person without foresight	−0.142	(0.152)	−0.161	(0.152)	−0.219	(0.150)
In a couple	0.353***	(0.131)	0.435***	(0.134)	0.501***	(0.142)
Has dependent children	−0.156	(0.127)	−0.178	(0.133)	−0.088	(0.134)
Is in good health	0.059	(0.160)	0.013	(0.151)	0.005	(0.154)
Irregular career	−0.141	(0.102)	−0.114	(0.106)	−0.119	(0.106)
Has experienced breaks in career due to unemployment	0.121	(0.111)	0.146	(0.115)	0.147	(0.115)
Has experienced breaks in career for other reasons	−0.163	(0.124)	−0.067	(0.127)	−0.015	(0.127)

Notes: Estimate of a linear, first-difference model. The regressions are run with R using the "plm" procedure, the "fd" (first difference) model specification and a correction of the variance of the residuals with the Arellano method. Robust standard errors are in parentheses. * indicates that the coefficient is significant at the 10% level; ** at the 5% level; *** at the 1% level.
Source and coverage: PAT€R surveys 2012 and 2020. Respondents common to the two waves, excluding retired people, i.e. 444 observations.

Table A3-3 – **Estimated change in the concern score for personal entitlements**

	Without age (1)		Without constant (2)		DAI in brackets (3)		With knowledge (4)	
Ref.: Net annual income: €12,000-19,999 and income not specified								
Net annual income: < €12,000	0.262	(0.197)	0.278	(0.200)	0.295	(0.201)	0.259	(0.195)
Net annual income: €20,000-29,999	0.068	(0.183)	0.041	(0.184)	0.038	(0.184)	0.061	(0.183)
Net annual income: €30,000 and above	0.280	(0.250)	0.282	(0.255)	0.269	(0.252)	0.296	(0.253)
Risk-taker	0.329	(0.273)	0.331	(0.274)	0.364	(0.273)	0.313	(0.274)
Person without foresight	0.069	(0.282)	0.110	(0.278)	0.101	(0.280)	0.080	(0.281)
In a couple	−0.460**	(0.234)	−0.512**	(0.228)	−0.546**	(0.230)	−0.431*	(0.235)
Has dependent children	0.033	(0.189)	0.013	(0.192)	0.005	(0.188)	−0.020	(0.191)
Is in good health	−0.029	(0.280)	−0.018	(0.280)	−0.019	(0.280)	−0.016	(0.276)
Irregular career	0.335	(0.221)	0.347	(0.221)	0.335	(0.222)	0.326	(0.221)
Has experienced breaks in career due to unemployment	0.191	(0.235)	0.160	(0.233)	0.186	(0.233)	0.188	(0.233)
Has experienced breaks in career for other reasons	0.163	(0.203)	0.084	(0.201)	0.110	(0.199)	0.072	(0.202)

Notes: Estimate of a linear, first-difference model. The regressions are run with R using the "plm" procedure, the "fd" (first difference) model specification and a correction of the variance of the residuals with the Arellano method. Robust standard errors are in parentheses. * indicates that the coefficient is significant at the 10% level; ** at the 5% level; *** at the 1% level.
Source and coverage: PAT€R surveys 2012 and 2020. Respondents common to the two waves, excluding retired people, i.e. 444 observation.

Financial Outlook for the Pension System and the Standard of Living of Pensioners by 2070

Frédérique Nortier-Ribordy*

Abstract – The outlook for changes in the share of pension expenditure in GDP depends heavily on assumptions of future productivity. If labour productivity were to increase by an average of 1.6% per year, the ratio of pension expenditure to GDP would be stable or decreasing from 2032, to settle at 12.1% in 2070, compared to 14.7% if productivity were to increase by only 0.7%. This stability or even decrease in the share of pension expenditure may seem counter-intuitive in view of the expected ageing of the population. The increase in the retirement age from 62 to 64, as a result of reforms adopted, and the smaller increase in pensions compared to earned income would, in effect, counterbalance this ageing. The standard of living of pensioners would thus be between 75.5% and 87.2% of the standard of living of the whole population in 2070, whereas it has been broadly equivalent since the early 2000s.

JEL: H55, I38, J12, J14
Keywords: retirement, standard of living, demographics and public spending

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For around thirty years now, pensions have held an important place in public debate: a number of reforms have been proposed or adopted, triggering significant social movements, and many reports have made a diagnosis regarding the outlook for the pension system.[1] This outlook must be long-term: retirement is an operation that is built up and carried out over the entire life cycle, and reforms are being implemented relatively slowly. Until the early 2000s, these reports did not necessarily achieve a consensus among stakeholders, government and social partners, in particular. The creation of the Conseil d'orientation des retraites (COR, French Pension Policy Council) in 2000 aimed to correct this pitfall by involving parliamentarians, social partners, experts and government representatives in the various stages of establishing projections (selection of assumptions and validation of results). This joint work on the outlook for the pension system, which remains a distinctive French feature, makes it possible to reach a consensus on the diagnosis and to frame the debates during the reform projects.

One of the missions entrusted to the COR since its creation is thus "to describe the medium and long-term developments and outlooks for legally compulsory pension schemes, in the light of economic, social and demographic developments, and to draw up […] projections of their financial situation."[2] This mission was bolstered by the law of 20 January 2014 guaranteeing the future and justice of the pension system, which establishes the production by the COR of an annual report on the pension system. It enables the Comité de suivi des retraites (CSR, French Pension Monitoring Committee) to determine whether or not the pension system is significantly deviating from its objectives, in particular that of financial sustainability and a satisfactory standard of living for pensioners.

The purpose of this article is to present the main results of the financial and standard of living projections for pensioners up to 2070, prepared for the COR Annual Report published in September 2022 (Conseil d'orientation des retraites, 2022). These projections were used as the basis for discussions on the government's reform project examined in early 2023, the implementation of which has been announced for the summer of 2023.

Since the future is inherently uncertain, not only in the short-term but also, and even more so, in the medium and long-term, making projections requires making assumptions about the regulatory,[3] demographic and economic developments on which the pension system depends. Both the projected situation of the French pension system and the relative pension for pensioners, in comparison with active workers incomes, are particularly sensitive to demographic and economic developments (Box 1). The first Section reviews these assumptions and, in particular, those of the four scenarios selected by the COR, which differ according to the labour productivity assumption used.[4] The second Section sets out the change in the share of pension expenditure in GDP and its components up to 2070, based on these four scenarios and the third Section sets out the change in the balance between pension resources and expenditure. The fourth Section discusses the sensitivity of the financial situation of the pension system to the various demographic and economic assumptions. Lastly, the fifth and final Section examines the change in the standard of living of pensioners.

1. The Projection Assumptions Used by the COR

To establish its projections, the COR uses INSEE's central scenarios as demographic and labour force assumptions. In turn, the selection of long-term economic targets (labour productivity growth and unemployment rate) is the result of a discussion and consensus among COR members, a consensus built on the work and studies available on the subject (Box 2). The selection of contrasting assumptions is necessary given the COR's mission to inform public debate on pensions in the most transparent way possible. It therefore provides information on the projected pension situation both in proactive economic scenarios, which entail breaks in trends compared to the recent past, and in more pessimistic scenarios. In this context, covering a broad range of possibilities makes the question of whether some economic assumptions are more relevant than others – a question that

1. For the most well-known: Commissariat général du Plan (1991), Charpin (1999), Insee (1990).
2. Paragraph 1 of Article L114-2 of the French Social Security Code.
3. Since one of the ways in which the projections are used is to inform decision-making relating to possible changes to pension rules, it is necessary to determine the spontaneous developments that would occur in the absence of such changes. To that end, the COR carries out its projections "on the basis of unchanged legislation", i.e. by taking into account only the pension rules already adopted, and does not attempt to anticipate possible future pension reforms, reforms which would also make it difficult for its members to reach consensus.
4. Some assumptions are used to a greater extent than others, so as to avoid having an excessive amount of results that would make it impossible to read the financial situation of the pension system. This is the case for labour productivity assumptions with cumulative effects over the projection horizon, given the indexation of entitlements and pensions on prices.

Box 1 – **Why Are Demographic and Economic Assumptions Necessary?**

The share of pension expenditure in GDP is calculated as follows:

$$\text{Share of expenditure} = \frac{\textit{Pension expenditure}}{\textit{GDP}}$$

With a constant sharing of wealth between capital and labour, the change in the share of pension expenditure in GDP can be written as follows:

$$\Delta\, \textit{share of expenditure} = \Delta\left(\frac{\textit{Number of pensioners}}{\textit{Number of contributors}}\right) \times \Delta\left(\frac{\textit{Average pension}}{\textit{Average income from employment}}\right)$$

The change of share of pension expenditure in GDP will thus depend on two factors which are a function of the demographic and economic conditions (over which pension system managers have no direct influence at first) and of the pension system's own rules (which do result from its management):

The ratio between the number of contributors and the number of pensioners (or demographic ratio) depends on demographic conditions (fertility, mortality and migration balance), employment behaviour at all stages of life and the unemployment rate. The "spontaneous" development of this ratio can be counterbalanced by the rules of the pension system (especially those that affect the effective retirement ages).

The ratio between the average pension of all pensioners and the average income from employment of all employed persons (or relative pension) depends not only on the general economic framework (particularly labour productivity) but also on the rules determining pension amounts (rules for calculating pensions on pay out, rules for indexing entitlements and pensions, etc.).

With a change that takes these two factors into account, at constant contribution rates, the share of pension expenditure in GDP thus becomes independent of the effects of demographic shocks (birth rate and migration) or economic shocks (unemployment and productivity) whereas the French pension system is currently particularly sensitive to the growth assumption used, due to price indexation, and to demographic changes which are only partially taken into account in the calculation of entitlements and pensions,[(i)] as noted by the CSR and in academic work (Blanchet *et al.*, 2016).

(i) The extension of the insurance period provided for in the 2003 law established that life expectancy gains were to be divided as follows: 2/3 for the contribution period and 1/3 for retirement.

Box 2 – **The Selection of Labour Productivity Assumptions**

In 2021, the COR wanted to engage in a process of reflection and discussion around long-term growth scenarios involving a broad panel of experts, in order to ensure the richness of debates and the variety of points of view. Indeed, the rate of growth of hourly labour productivity in France has reached the lowest level observed in a century (excluding periods of war) and this slowdown has been observed for many developed countries. Debates between economists are thus multiplying as to the reasons for this slowdown and the outlook for future productivity developments in France, and there remains a split between "techno-optimists" and "techno-pessimists" about the future of productivity gains – especially regarding the possibility of a positive productivity shock linked to the digital revolution.

At the end of the discussions, a consensus was reached among COR members for a downward revision of productivity targets compared to those used in previous years. Pension system projections will now be based on four productivity scenarios: 1.0% and 1.3%, which were two assumptions previously used, and two new assumptions of 0.7% and 1.6%, with a single long-term unemployment rate. The 1.0% scenario thus became an intermediate scenario rather than an extreme scenario. The most favourable assumption is long-term hourly productivity growth (1982-2019), the least favourable is the average hourly productivity recorded over the last decade (2009-2019). The intermediate assumptions (1.0% and 1.3%) reflect productivity growth in France over the last 20 and 30 years, respectively.

would be key if a single scenario were to be used – less crucial.

Once the overall demographic and economic framework has been established, and since the French pension system is composed of more than forty schemes, each with its own calculation rules and contribution rates, it is necessary to break it down by scheme. This breakdown is particularly important for public pension schemes, given the way in which they calculate the pension and their contribution rate.

1.1. The Demographic and Labour Force Assumptions

The projection assumptions used by the COR are constructed based on the central scenario of INSEE's demographic and labour force assumptions (Algava & Blanpain, 2021; Bechichi *et al.*,

2022). Sensitivity tests are studied for each of the demographic components: fertility, mortality and migration balance.[5] On the other hand, no activity rate variant is studied.

The demographic projections published by INSEE in November 2021 update those for 2016 by integrating recent demographic developments. Compared to 2016, the central fertility and life expectancy assumptions have been revised downwards (Blanpain & Buisson, 2016).[6]

Fertility is assumed to settle at 1.8 children per woman from 2022 onwards (Table 1), a less favourable assumption than that previously adopted (1.95 children per woman). Two alternative assumptions are studied: a low assumption in which fertility would decrease from 1.8 in 2022 to 1.6 in 2030 and stabilise at that level until 2070 and a high assumption in which it would increase to 2 between 2022 and 2030 and then stabilise. The range of assumptions envisaged thus remains below the threshold for the renewal of generations.

Mortality would continue to fall in the projection, but less sharply than projected in 2016. In the central scenario, life expectancy at age 60 would reach 31.3 years for women in 2070, 2.3 years lower than expected in 2016, and 29.3 years for men, which is 1.7 years lower. INSEE has taken into account the slowdown in life expectancy gains observed since 2014. Between 2014 and 2019, life expectancy at age 60 increased by only 0.1 years for women and 0.3 years for men,[7] compared to 1.5 to 2 years per decade before 2014. Alternative assumptions are also taken into consideration: in the low assumption, men and women would live for 2.8 years less at age 60 in 2070 and, in the high assumption, women would live 3.1 years longer and men 3 years longer.

The migration balance is the difference between the number of people entering the territory and the number of people leaving over the course of a year. It is quite volatile by nature and, therefore, difficult to predict. The assumption adopted by INSEE was maintained at +70,000 in the demographic projections for 2021-2070, with a low variant at +20,000 and a high variant at +120,000. However, the age structure of the migration balance has been amended to take account of recent developments: the average age of net inflows would thus be older (Conseil d'orientation des retraites, 2022).

As regards the labour force, the COR projections also rely on the scenario of INSEE's latest projections, which extends the major demographic and activity trends (Bechichi *et al*., 2022). The number of people in the labour force increased by an average of 0.5% per year between 2002 and 2021, when the labour force reached 30.1 million people. The gradual retirement of the baby boom generations beginning in 2006 was partially offset by the increase in activity among older people due to the higher retirement age, the increase in activity among women and, to a lesser extent, the increase in activity among young people. According to INSEE's new projections, the labour force would continue to grow over the next two decades, at a slower rate (0.1% per year on average). The trend would reverse from 2040, with an average annual decline of 0.1%. The labour force would peak at 30.5 million people

5. The activity rates by age group and gender in INSEE's central scenario are applied to the population studied in the variant to determine the labour force.

6. The COR had largely anticipated this decrease by using the low fertility and life expectancy assumptions of the previous demographic projection exercise for its annual report, from 2021 onwards, while retaining the central migration balance assumption. This choice is confirmed a posteriori *since the central scenario of INSEE's new demographic projections is very close to the scenario combining the low fertility, low life expectancy and central migration balance from the previous year.*

7. So, extending this trend, only 0.2 years and 0.6 years per decade for women and men respectively.

Table 1 – **INSEE's population projection assumptions from 2016 and 2021**

Assumptions	2016 central	2021		
		Central	Low	High
Fertility	1.95 over the entire period	1.80 from 2023 onwards	1.60 from 2030 onwards	2.00 from 2030 onwards
Life expectancy for women at age 60	32.5 years in 2060 and 33.6 years in 2070	31.3 years in 2070	28.5 years in 2070	34.4 years in 2070
Life expectancy for men at age 60	29.7 years in 2060 and 31 years in 2070	29.3 years in 2070	26.5 years in 2070	32.3 years in 2070
Migratory balance	+70,000 over the entire period	+70,000 per year over the entire period	+20,000 per year over the entire period	+120,000 per year over the entire period

Sources: INSEE, population projections 2013-2070 and 2021-2070.

in 2040 before falling to 29.2 million in 2070. The decrease beyond 2040 is mainly explained by the decrease in the working-age population, as activity behaviour will have stabilised.

1.2. Long-Term Labour Productivity and Unemployment Rate Assumptions

In addition to demographic and activity assumptions, pension projections require assumptions about hourly labour productivity growth and the unemployment rate. The development of productivity determines the development of wages and ultimately pensions, while that of the unemployment rate determines employment with a given labour force (Table 2). Based on these assumptions, it is then possible to deduce GDP growth, which is equal to the product of the growth of apparent labour productivity per capita and of employment. The COR assumes that the sharing of value added between wages and capital remuneration and working hours are stable in its projection.

The scenarios, constructed by the Direction générale du Trésor (the French Treasury), establish three distinct periods (Direction générale du Trésor, 2021).

In the short-term (2022-2027), as provided for by law, the assumptions are those used by the government in the Stability Programme for 2022 (Direction générale du Trésor, 2022). In the long-term (from 2032), the targets set by the COR for the development of labour productivity and the unemployment rate will determine GDP growth. It is assumed that the unemployment rate will stabilise from a certain date onwards, so its impact becomes constant in the long-term. The growth of labour productivity and that of earnings per capita are inverse to cumulative processes; therefore, their impact increases over time. This is why the COR identifies four scenarios for long-term hourly labour productivity gains (0.7% scenario, 1.0% scenario, 1.3% scenario and 1.6% scenario) associated with a single unemployment rate assumption.

Between the two periods (2022-2027 and 2032-2070), the transition is gradual and may create some artefacts in growth if long-term targets prove to be far from short-term assumptions. In the 2022 Stability Programme, the government predicts that full employment would be achieved in 2027 and that the unemployment rate would be 5% by that date, which is two percentage points lower than the target set by the COR for its annual report (7%). As employment results from the unemployment rate in the construction of the COR scenarios, the rise in unemployment mechanically translates into job losses that generate a very sharp slowdown in growth over the years 2027-2032.[8] The assumptions of the Stability programme were not yet known when the COR members chose the long-term unemployment assumption, and they "preferred to retain the 7% assumption, having often been criticised for the excessive optimism of the low 4.5% assumption", as noted by the CSR in its ninth opinion (Comité de suivi des retraites, 2022). However, there is no reason to expect that the economic situation will be particularly depressed over the period 2027-2032. The CSR notes that "the artificial nature of the connection in the 7% assumption obviously poses a problem" and considers that it "would be useful to public debate to have a small set of complementary projections that, at least, correct this lack of connection […] (the results are in any case less dependent on the unemployment assumptions than on the productivity assumptions). These projections would take advantage of this to incorporate the development of very short-term growth forecasts"; the CSR notes that, on the contrary, the short-term forecasts may appear optimistic in view of the international context and current inflation. This is why all of the financial results are presented here using an unemployment rate of 4.5% from 2032 onwards.[9] However, it was not possible to

8. This break in trend does not appear in previous reports. For example, in 2021, the stability programme forecast an unemployment rate of 8.4% in 2027. The achievement of long-term growth targets was thus linear over the period 2027-2032.

9. It should be noted that in its reform proposal presented to the Council of Ministers on 23 January 2023, the government uses the scenario based on productivity growth of 1.0% and an unemployment rate of 4.5% from 2032 onwards for its assumption.

Table 2 – **Long-term assumptions in the COR's scenarios and variants**

Unemployment rate (%)	Annual labour productivity growth (long-term values achieved from 2032 onwards)			
	0.7%	1.0%	1.3%	1.6%
4.5	0.7% scenario	1.0% scenario	1.3% scenario	1.6% scenario
7.0		Variant (7% - 1.0%)		

Sources: COR assumptions, 2022.

incorporate new short-term forecasts, as these are the responsibility of the French Treasury.

In order to assess the sensitivity of the projection results to the unemployment assumption, the assumption of an eventual unemployment rate of 7% is nevertheless studied. This variant is paired, by convention, with the 1.0% productivity growth scenario, though this does not give that scenario the role of a central scenario.

1.3. Assumptions Regarding the Civil Service

Once the demographic and economic assumptions have been established, they are broken down into assumptions regarding the number of social security contributors and the average per capita tax base for each scheme, in order to take into account the respective dynamics of remuneration and employment between private sector employees, civil servants and the self-employed. This breakdown is particularly important for the civil service. Firstly, the pensions of civil servants are calculated on the basis of the index-linked salary. Thus, the more moderate the change in the value of the index point, the lower the retirement pensions of civil servants when paid out. This effect is immediately reflected in pension expenditure, since the salary for the final six months is used as a reference for the calculation of civil servants' pensions, while it would be more spread over time for private sector employees, for whom the calculation of pensions takes into account their entire career. Secondly, since employer contributions are higher in the civil service than in the private sector − due to the balancing contribution paid for the State civil service scheme and a higher contribution rate than in the private sector for the scheme for regional and hospital civil servants (Caisse Nationale de Retraites des Agents des Collectivités Locales − CNRACL) − any distortion in the sharing of pensionable remuneration between the public and the private sector has an effect on the proportion of resources allocated to funding the pension system.[10]

The assumptions on remuneration in the civil service, provided by the Budget Directorate of the Ministry of Economy and Finance, thus forecast very moderate increases in civil servants' wages in the coming years. From 2023 to 2027, the annual increase in the average index-linked salary would be limited to +0.1% in current euro, after the 3.5% increase in July 2022 and excluding the effects of the *Ségur de la santé* healthcare service consultation. From 2027 to 2032, the rate of growth of the average index-linked salary would be +0.1% per year in constant euro and then, between 2032 and 2037, it would match that of private sector wages (between 0.7% and 1.6% depending on the scenarios). The share of premiums would increase from 2027 to 2037, while index-linked salary growth would match private sector wage growth. Beyond 2037 and up to 2070, the development would be parallel in the civil service and the private sector.

2. The Share of Pension Expenditure in GDP Would Decrease in the Future in Three Out of Four Scenarios

These assumptions relating to demographic and economic developments, as well as those concerning jobs and remuneration in the civil service, make it possible to deduce how pension expenditure will change between 2023 and 2070. In addition, the projections are made on the basis of unchanged legislation, with the COR annual report being intended to provide a diagnosis shared by the members of the board regarding the pension system.

2.1. A High Level of Sensitivity to the Productivity Assumptions Used

With EUR 345.1 billion paid out in 2021, gross expenditure on the pension system amounted to 13.8% of GDP, after an exceptional 14.7% in 2020 due to the sharp contraction in GDP linked to the health crisis. While this level may seem high, it should be stressed that without the measures taken in respect of pensions over the last 30 years, pension expenditure as a proportion of GDP would be higher by about 4.3 percentage points of GDP, in particular due to the index-linking of pensions to prices.[11]

Between 2002 and 2021, pension expenditure increased by an average of 2% per year in real terms. This increase is mainly explained by the steady increase in the number of pensioners (+1.7% on annual average), especially with the large baby boom generations reaching retirement age from 2006 onwards and, to a much lesser extent, by the increase in their average pension (+0.4% on annual average). In turn, real GDP growth was significantly lower, as an

10. With a pension system fully financed by social security contributions and the same contribution rate for all schemes, the amount of resources as a proportion of GDP would be stable over time.

11. By 2070, depending on the productivity assumption adopted, price-linked indexation would reduce pension expenditure as a proportion of GDP by 3.5 to 5.5 percentage points, while the combination of all the other measures implemented during the reforms of 1993, 2003, 2010 and 2014 would have an effect on this horizon of 2.4 to 2.8 GDP percentage points, an impact that is much less dependent on the productivity assumption (Marino, 2014; Bozio, 2021).

annual average (1.1%), than that of expenditure, mainly due to the economic crisis of 2008-2009 and the health crisis of 2020.

As a result, the share of pension expenditure in GDP increased by 2.1 percentage points between 2002 and 2021, from 11.7% to 13.8% (Figure I). After reaching a high point in 2014 (14.1%), the share of pension expenditure in GDP then fell steadily from 2014 to 2019 (−0.5 GDP percentage points), due to the recovery of activity and the measures implemented in respect of pensions, in particular, the under-indexation of pensions. For the past two years, it has been severely buffeted by the health crisis and its effects on GDP: it rose by 1.1 percentage points between 2019 and 2020 before falling by 0.9 percentage points in 2021 in connection with the strong recovery in activity.

Looking at the outlook, real-terms pension expenditure would increase by between 1.6% and 1.7% according to the annual average scenarios between 2022 and 2032, slightly higher than real GDP (between 1.3% and 1.6%). In terms of value, i.e. once price developments are taken into account, the share of pension expenditure in GDP would thus increase significantly over the next ten years, though to a greater or lesser extent: it would vary between 14.2% and 14.7% of GDP in 2032, depending on the scenario.

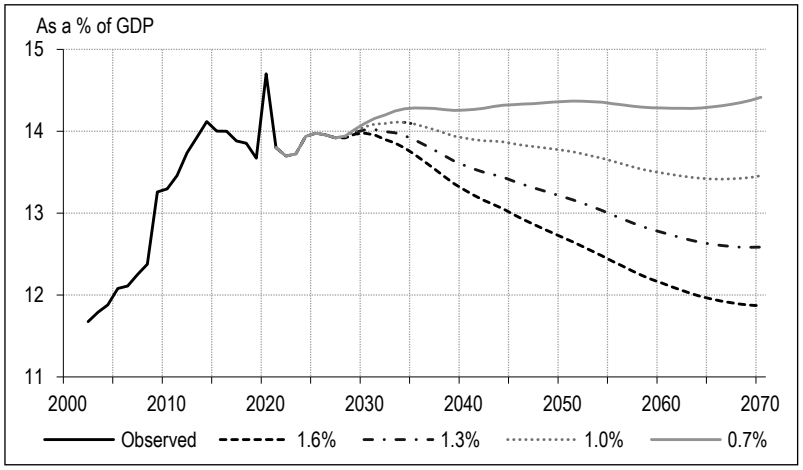
Between 2033 and 2055, the pace of growth in pension expenditure would slow, ranging from 0.7% to 1.0% per year in real terms under the 1.0% to 1.6% scenarios, which is lower than real GDP growth which would range from 0.9% to 1.5%. As a result, pension expenditure as a proportion of GDP would fall in these three scenarios, ranging from 12.7% (1.6% scenario) to 13.8% (1.0% scenario) in 2055. It would stabilise under the 0.7% scenario, in which both expenditure and real GDP would increase by 0.6% in real terms per year, and would then be 14.7% of GDP in 2055.

Between 2056 and 2070, real-terms pension expenditure would increase slightly more than in the previous period, while the pace of GDP growth would be stable. Pension expenditure as a proportion of GDP would continue to fall, but less rapidly in scenarios in which productivity growth is at least 1.0% and it would be stable in the 0.7% scenario. By 2070, as a proportion, pension expenditure would vary between 11.9% of GDP (1.6% scenario) and 14.4% of GDP (0.7% scenario), compared to 13.8% in 2021. The difference between the various assumptions would thus be 2.6 percentage points.

2.2. The Determining Factors of the Share of Pension Expenditure in GDP

Despite the gradual ageing of the French population, under the assumptions envisaged, from 2032 onwards, pension expenditure as a proportion of French national wealth would remain stable or would fall. This result may seem counter-intuitive in view of the expected ageing of the population. The ratio between the number of contributors and the number of pensioners would thus decrease significantly, from 1.7 contributors per pensioner with a direct pension

Figure I – **Share of pension system expenditure in GDP, observed and projected with an unemployment rate of 4.5% from 2032 onwards**



Notes: Data excluding financial income and charges, excluding allocations and recoveries from provisions. From 2020 onwards, the accounts of the CRPNPAC (Supplementary civil aviation aircrew scheme) are included.
Coverage: All legally compulsory French pension schemes, including the Old-Age Solidarity Fund (FSV), excluding the Civil Service Supplementary Pension Scheme (RAFP).
Sources: Reports to the CCSS 2002–2021; COR projections – September 2022.

entitlement[12] in 2021 to about 1.3 by the projection horizon (Figure II-A). This decrease would be observed even though the cohort size-free retirement age[13] would go from 62.3 years old in 2020 to almost 64 years old from the late 2030s due to the reforms already adopted. It would also be counterbalanced by the fact that the average pension for pensioners would continue to grow in constant euro, but slower than the average income from employment. The average pension would thus vary between 33% (1.6% scenario) and 39.9% (0.7% scenario) of the average income from employment in 2070, compared to 50.3% in 2021 (Figure II-B). The indexation of entitlements and pensions to prices has the effect of widening the gap between pensions (both those of people who are already retired and those of future pensioners) and income from employment. The effect builds year on year and is all the stronger as labour market income growth is high in comparison with inflation, making the pension expenditure as a proportion of GDP very sensitive to the pace of real-terms growth in labour productivity and income from employment until the mid 2050s (Marino, 2014; Bozio, 2021).

This decrease in the relative average pension should not be interpreted as impoverishing future generations of pensioners in real terms: the average pension would continue to grow in constant euro with the *Noria* effect,[14] but less rapidly than average income from employment. It would thus increase by between 0.2% (0.7% scenario) and 0.6% (1.6% scenario) on average per year, while average income from employment would increase by between 0.7% and 1.4% per year between 2021 and 2070.

2.3. A breakdown of the share of pension expenditure in GDP

The share of pension expenditure in GDP evolves mainly as a result of three main components: demographic, economic and regulatory. The following breakdown allows us to isolate their contribution to this evolution:

- The demographic ratio reflects the ageing of the population, measured by the ratio between the number of people of retirement age (here, those aged 60 and over) and the number of people of working age (here, aged 20-59).

- The economic context takes into account the sharing of the wealth produced and the inverse of the employment rate.[15]

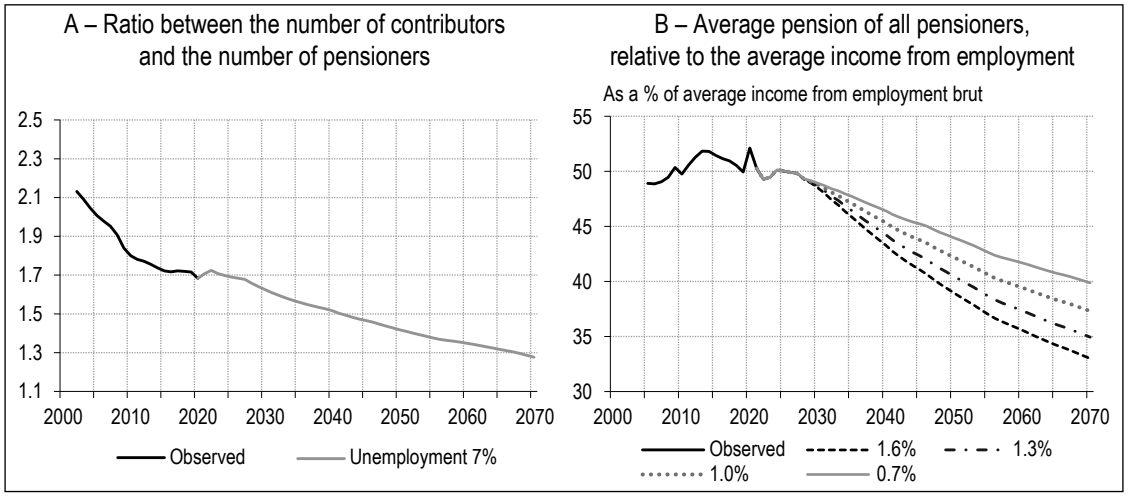
- The rate of pensioners reflects changes in retirement ages.

- The relative pension is an indicator of the degree of protection afforded by the pension system.

- The residual takes into account several aspects not covered in the breakdown (e.g. the difference

12. Pensioners with direct pension entitlements are those who have acquired at least their own pension entitlement resulting from their contribution to a French pension scheme. Pensioners in receipt of a reversion pension only are therefore excluded from this definition.
13. The cohort size-free retirement age depends on the likelihood of being retired at each age between the ages of 50 and 70. It corresponds to the average retirement age for a fictitious generation which would have, at each age, the same proportion of pensioners as that observed in a given year (Secrétariat général du Conseil d'orientation des retraites, 2015).
14. The Noria *effect refers to the development of the average pension linked to the renewal of the population of pensioners: the new generations, whose pensions are on average higher, gradually replace the older generations with lower pensions.*
15. The inverse of the ratio used here is slightly different from the usual ratio, which relates the number of people aged 20 to 59 to the total number of employed people of those same ages.

Figure II – **Determining factors in the development of the total pension amount**



Reading note: In 2020, 1.7 persons were employed for every 1 pensioner with their own entitlement (all schemes combined) and the average gross pension amount of all pensioners with their own entitlements represented 50.3% of the average income from employment (excluding part-time employment).
Coverage: All legally compulsory French pension schemes, excluding the Civil Service Supplementary Pension Scheme (RAFP) Pensioners with at least one pension entitlement of their own.
Sources: COR projections, INSEE national accounts – September 2022 and DREES, ANCETRE 2020 model.

$$
\begin{aligned}
&Share\ of\ pension\ expenditure\ in\ GDP \\
&= \\
&\left.\frac{population\ aged\ 60\ and\ over}{population\ aged\ 20-59}\right\} \quad \text{❶ Demographic ratio} \\
&\times \\
&\left.\frac{average\ earnings}{output\ per\ capita} \times \frac{population\ aged\ 20-59}{employed\ population}\right\} \quad \text{❷ Economic context} \\
&\times \\
&\left.\begin{array}{l}
\dfrac{number\ of\ pensioners\ all\ ages}{population\ 60\ and\ over} \quad \Rightarrow \text{Rate of pensioners} \\
\times \\
\dfrac{average\ pension}{average\ earnings} \\
\times \\
residual \quad \Rightarrow \text{Relative pension}
\end{array}\right\} \quad \text{❸ Rules of the pension system}
\end{aligned}
$$

between pension benefits paid to pensioners and total pension expenditure including management fees).

The contribution of each component (demographic ratio, rate of pensioners, etc.) to the development of pension expenditure as a proportion of GDP between year n and year $n+x$ is calculated as follows:

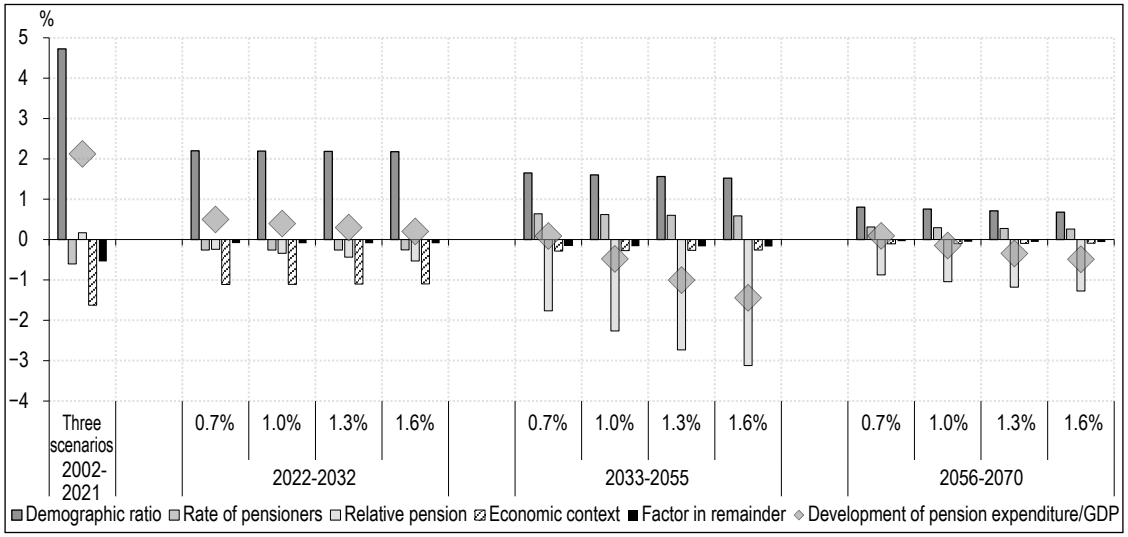
$$
\begin{aligned}
&Component\ contribution \\
&= \frac{\left(component_{n+x} - component_{n}\right)}{average\left(\dfrac{dep_{n}}{component_{n}}; \dfrac{dep_{n+x}}{component_{n+x}}\right)}
\end{aligned}
$$

where dep_n = share of pension expenditure in GDP for year n.

From 2002 to 2021, the share of pension expenditure in GDP increased by 2.1 percentage points, mainly due to ageing (Figure III).

The demographic ratio fell from 2.7 to 1.8 over this period and contributed 4.7 percentage points to this increase. Due to the increase in the retirement age, the rate of pensioners contributed negatively (−0.6 percentage points). Similarly, the increase in the employment rates of both women and men over the age of 50 has led to the economic context contributing to a decrease

Figure III – **Change in the share of pension expenditure in GDP, observed and projected and contributions to that change**



Notes: The country's demographic ratio is the ratio between the population aged 60 and over and the population aged 20 to 59. The labour market is the inverse of the employment rate (measured as the total number of people in employment relative to the population aged 20 to 64). Finally, the rules of the pension system can be understood through the rate of pensioners (total number of pensioners per person aged 60 and over) and the average pension relative to the average income from employment.
Reading note: Between 2022 and 2032, the share of pension expenditure in GDP would increase by 0.2 percentage points in the 1.6% scenario with an unemployment rate of 4.5%. The economic context, the rate of pensioners and the relative pension would contribute to a decrease in this proportion of 1.1, 0.3 and 0.5 percentage points respectively, while the ageing population would contribute to increasing it by 2.2 percentage points.
Sources: COR projections – September 2022.

in the share of retirement expenditure in GDP (−1.6 percentage points).

By contrast, the relative pension increased slightly and contributed positively to the change in the share of pension expenditure in GDP (0.2 percentage points). The average pension continued to increase, due in particular to the improvement in the pension of newly retired women (linked to longer careers), but this growth has slowed significantly. Firstly, the price indexation of pensions moderated the development of the average pension for pensioners. In addition to this structural slowdown factor, there have been smaller revaluations in relation to inflation over the recent period (shift of the revaluation dates from 2014 to 2018 and under-indexation in 2019 and 2020 for basic pensions; freezing of the point value from 2013 to 2018, then undervaluation in 2019 and 2020 for supplementary pensions). Secondly, replacement rates are falling across all schemes. In the basic scheme, this decrease is due to the price indexation of entitlements for private sector employees;[16] for civil servants, it can be attributed to the increase in the premium rate and the freezing of the index point value. In the AGIRC-ARRCO compulsory supplementary pension private sector scheme, it is linked to the decline in the scheme's performance since 1990: for one euro of contributions, accrued entitlements are about half what they were 30 years ago (Nortier-Ribordy, 2016).

As regards the outlook, under any scenario, between 2022 and 2032, pension expenditure as a proportion of GDP would increase (from 0.2 to 0.5 percentage points of GDP). The ageing of the population (which contributes 2.2 percentage points) would be partially offset by the gradual increase in the retirement age due to the increase in the insurance period required to access the full rate. The improvement in the economic context and the decrease in the rate of pensioners would thus contribute to a decrease of 1.1 and 0.3 percentage points, respectively, of the share of pension expenditure in GDP. The development of the relative pension would have a varying contribution depending on the scenarios, of around −0.2 to −0.5 percentage points. The decline in replacement rates would continue in the AGIRC-ARRCO scheme and in the civil service schemes because of the assumptions used regarding civil service remuneration (very moderate increase in the index point value until 2037 and increase in the premium rate from 2027 to 2032). In the basic scheme for private sector employees, replacement rates would continue to fall, due to the price indexation of entitlements.

From 2033 to 2055, the share of pension expenditure would be almost stable in the 0.7% scenario and would decline in the other three scenarios (from −0.5 to −1.5 percentage points). The demographic ratio would continue to play a positive role in the development of pension expenditure as a proportion of GDP (1.6 to 1.7 percentage points), while in the absence of further reforms to increase the retirement age, the contribution of the rate of pensioners would be positive (0.6 percentage points). This positive contribution would be linked to the ageing of the retired population. The improvement in employment rates would continue to have a slight negative effect on pension expenditure as a proportion of GDP (−0.3 percentage points).

The decrease in the share of pension expenditure in GDP would thus be largely attributable to the decrease in the relative pension, the contribution of which would vary between −1.9 and −3.3 percentage points. This is an unexpected finding in the sense that the effects of the price indexation of entitlements should stabilise during this period.[17] Firstly, the modest growth in income from employment and the level of unemployment observed since the early 2000s have an effect on the constitution of pension entitlements, which would later affect the level of pensions at the time they are paid out. Thus, average wage growth over the previous 25 years would only align with annual wage growth (between 0.7% and 1.6% per year) from 2050 onwards. Secondly, the effects of the decrease in the performance of the AGIRC-ARRCO scheme, which would only stabilise from 2033 onwards, would continue to spread as the generations concerned reached retirement age. Replacement rates would also continue to fall in the State civil service due to the decrease in the average pro-rata coefficient over the generations following later entries into the State civil service scheme (Secrétariat général du Conseil d'orientation des retraites, 2023).

Finally, from 2055 to 2070, the share of pension expenditure in GDP would gradually stabilise in all scenarios. The ageing population would be offset by the decrease in the relative pension. This decrease would come almost exclusively from the AGIRC-ARRCO scheme and, to a lesser extent, from the increase in retirement

16. The increase in the length of insurance required for the payment of pensions at full rate, provided for in the reforms, which leads to an increase in the retirement age, also has a downward impact on the pro-rata coefficients of pensions.

17. Under steady conditions (constant wage growth, career duration and retirement duration), it is possible to demonstrate that the average pension increases in line with average earnings from employment.

duration. As the pensions of older pensioners are generally lower than those of younger pensioners due to the *Noria* effect, the extension of the retirement duration, which increases the proportion of older pensioners among the total number of pensioners, mechanically helps to slow the growth of the average pension.

3. The Balance of the Pension System Depends on the Convention Selected

3.1. How Should The Resources of the Pension System Be Measured?

Normally, a pay-as-you-go pension scheme is financed by contributions from employed workers levied from their gross wages[18] at a specified contribution rate. In this case, in the same way as expenditure, the resources of the pension system are easy to project once the demographic and economic assumptions have been made. At unchanged contribution rates and when the sharing of value added between capital and labour is stable, the amount of resources as a proportion of GDP is stable. The resulting development of the balance (the gap between resources and expenditure) then reflects only the development of pension expenditure as a proportion of GDP.

In practice, however, some of the resources of the pension system come from funding sources other than contributions. Thus, 12% comes from the assumption of contributions by the State intended to ensure the financial balance of the State civil service scheme and other special schemes (SNCF, RATP, mining, seafarers or State workers' scheme) ; 12% comes from tax revenues (including the General Social Contribution [*contribution sociale généralisée* – CSG]) paid by active and retired workers ; and 9% comes from external bodies. The latter two sources of funding are intended to compensate for exemptions and reductions in contributions for low-wage earners, certain solidarity schemes (mainly family or unemployment benefits) or a very unfavourable demographic situation (farmer schemes). These resources are discretionary by nature. In particular, resources from the family branch of the social security system and the Unedic (*Union nationale interprofessionnelle pour l'emploi dans l'industrie et le commerce* - National Professional Union for Employment in Industry and Trade) decrease in the forecast because the assumptions predict fewer children and unemployed people than in recent years.

In addition, contribution rates differ across schemes. In particular, they are higher under the CNRACL scheme (scheme for civil servants working in local authorities and hospitals). However, the share of the remuneration of civil servants working in the Fonction publique territoriale (FPT - local authorities) and the Fonction publique hospitalière (FPH - hospitals) in total remuneration decreases under assumption, which leads to a decrease in the share of resources in GDP through a structural effect.

This is why the COR presents the resources and balance of the pension system in accordance with two accounting conventions for the State civil service scheme and other special schemes.

The EPR convention (for *Équilibre Permanent des Régimes*, meaning Permanent Balance of Schemes) aims to achieve a balance between the State pension scheme (but not that of civil servants working in local authorities and hospitals) and the special schemes each year. This convention reflects the current legislation governing the pension system and serves, *inter alia*, as a basis for discussions on social security funding laws. It has the advantage of providing an alert regarding the funding need of schemes that do not benefit from balancing subsidies, but it provides no structural indication of the financial situation of schemes that are financially balanced by the State (almost a quarter of the expenditure of the entire pension system).

The EEC convention (for *Effort de l'État Constant*, meaning Constant State Effort) in turn consists in stabilising the resources allocated to the State pension scheme and special balanced schemes as a proportion of GDP at the average value recorded between 2017 and 2021[19]. This convention, presented for illustration purposes only, makes it possible to highlight the redeployment of financial flows between the balanced schemes for which expenditure is expected to decrease and the other schemes, given that the State contribution to pension funding would remain constant as a proportion of GDP.

While these conventions are equivalent for the overall public financial situation, the level of the balance is very sensitive to the convention adopted for the projection. These differences are due to the fact that, depending on the

18. While there is a legal distinction between employer contributions and employee contributions, the final impact of the contributions is based on the number of employed people. See document N° 4 of the COR meeting of 17 October 2019 (Secrétariat général du Conseil d'orientation des retraites, 2019).

19. The name of the conventions has been changed since the COR report of November 2019 because the previous names were not explicit and linked the conventions to the institution (CCSS) or to an economic concept (GDP). The new names are intended to clarify the logic underlying each of the conventions.

conventions, the State contributes more or fewer resources to the pension system.

The financial situation of the pension system can be assessed year after year. But in a context of demographic change and/or economic fluctuations of a cyclical nature, it may also be of benefit to examine whether the funding needs observed in a given year will be offset by the surpluses of other years. The two indicators (annual balance and average balance over the projection period) are discussed in the following Section.

3.2. In Light of the Assumptions Used, the Pension System Would Have Funding Needs over the Next 25 Years

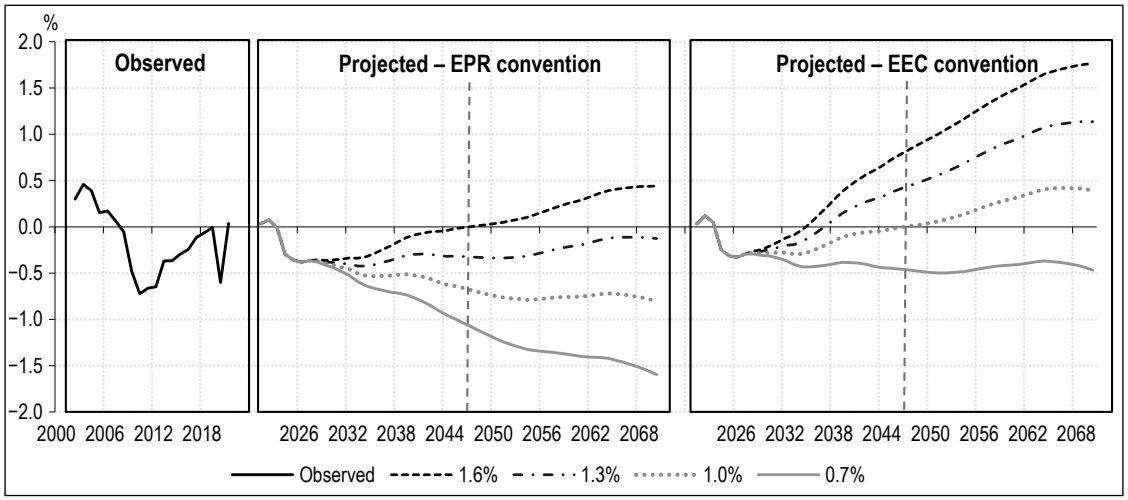
With the economic recovery seen in 2021, the balance of the pension system recovered: after having a funding requirement of around 0.6 percentage points of GDP in 2020, due to the health crisis, the pension system appears to have a surplus of 900 million euro in 2021. And this surplus is expected to increase in 2022 (3.2 billion euro under the EPR convention).

In the projection, its development, like that of the expenditure to GDP ratio, would be very sensitive to the pace of growth in remuneration from employment (or labour productivity) and the convention adopted (Figure IV).

Under the EPR convention, the balance of the pension system would remain negative over the projection horizon in three of the four scenarios, mainly due to the decrease in the share of resources in GDP. In the short-term, this decrease would be partly related to the decrease in resources from the CNRACL scheme due to the effect of the remuneration assumptions for civil servants. It is worth highlighting the paradoxical nature of this result, as the gains for public finances brought about by savings measures in relation to public sector payroll are reflected in a deterioration in the financial situation of the pension system. The deterioration in the balance would then be the result of the basic scheme for private sector employees. Between 2022 and 2070, the pension system would experience an average funding requirement of around −1.1 (0.7% scenario) to −0.3 (1.3% scenario) percentage points of GDP. The pension system would only return to equilibrium in the 1.6% scenario in the mid-2050s and would be just balanced in this scenario on average over the period. The balance would be between −1.9% of GDP (0.7% scenario) and 0.2% of GDP (1.6% scenario) in 2070.

Using the EEC convention, the pension system would gradually return to equilibrium in all scenarios but over a longer or shorter period of time (towards the mid-2030s in the 1.6% scenario, the mid-2040s in the 1.3% scenario and the late 2050s in the 1.0% scenario). It would continue to experience funding needs over the projection period in the 0.7% scenario. By 2070, the balance of the pension system would thus vary between −0.7% and 1.5% of GDP. Between 2022 and 2070, the pension system would have a

Figure IV – **Balance of the pension system according to the accounting convention used, observed and projected**



Notes: Data excluding financial income and charges, excluding allocations and recoveries from provisions. EEC convention: stabilisation of contributions and balancing grants as a proportion of GDP at their average level from 2017 to 2021. EPR convention: contributions and balancing grants changing so as to ensure equilibrium in the balance of these schemes each year. The dashed vertical bar indicates the 25-year control horizon defined by the CSR.
Coverage: All legally compulsory French pension schemes, including the Old-Age Solidarity Fund (FSV), excluding the Civil Service Supplementary Pension Scheme (RAFP).
Sources: Reports to the CCSS 2010–2021; COR projections – September 2022.

deficit on average in the 0.7% and 1.0% scenarios (respectively −0.6 and −0.4 percentage points of GDP), it would be just balanced in the 1.3% scenario and it would be in surplus in the 1.6% scenario (0.4 percentage points of GDP). This improvement in the financial situation of the pension system would be achieved in return for a greater financial contribution from the State as an employer than under the EPR convention and an equivalent deterioration in the State budget.

4. Sensitivity to the Economic and Demographic Assumptions

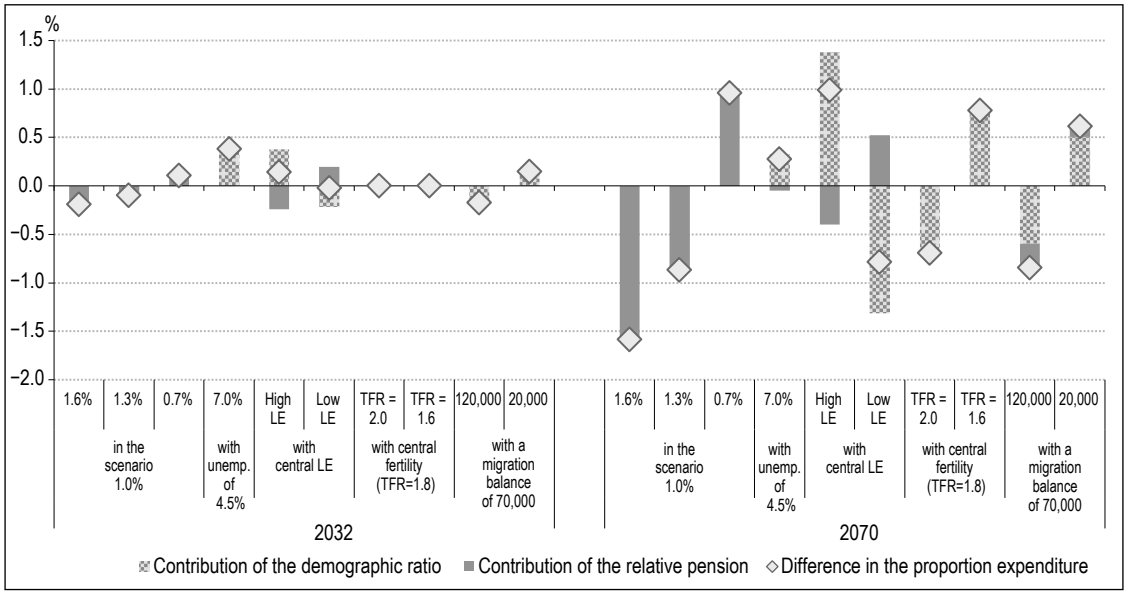
The outlook for the pension system is presented according to various labour productivity growth assumptions, associated with a single unemployment rate target (4.5%) and INSEE's central demographic and labour force scenarios. However, it is necessary to examine variants to assess the sensitivity of the results to these central assumptions. These variants are paired with the 1.0% labour productivity growth scenario, without making it a central scenario.

The number of contributors and pensioners and the average pension have been projected by changing each of the four variables (unemployment rate, fertility, mortality and migration balance) that differentiate the variants one by one, while leaving the other economic assumptions (labour productivity and employment rate by age) unchanged.

In the medium term (2032), the unemployment rate assumption would play a stronger role than all the other assumptions: in the case of an unemployment rate of 7% instead of 4.5%, the share of pension expenditure in GDP would be 0.4 percentage points of GDP higher than in the 1.0% scenario (in which it would be 14.1%). The differences would range from −0.2 percentage points (1.6% productivity scenario) to +0.2 percentage points (low migration balance) for the other assumptions (Figure V). In the long-term (2070), differences linked to productivity assumptions and demographic assumptions would continue to spread, while differences relating to unemployment would be slightly smaller than in 2032. The share of pension expenditure in GDP (13.5% in the 1.0% scenario) would thus be 1.6 percentage points lower if productivity increased by an average of 1.6% per year and 1 percentage point higher if productivity increased by only 0.7% per year. If life expectancy were higher, the difference would be around 1 percentage point and it would be −0.8 percentage points if it were lower. The fertility and migration balance assumptions would have effects of around 0.7 to 0.8 percentage points of GDP in the upward or downward direction.

These results are linked to the respective developments of the ratio between the number of contributors and the number of pensioners and the relative pension.

Figure V – **Sensitivity to economic and demographic assumptions of the projections of the share of pension expenditure in GDP in 2032 and 2070**



Reading note: In 2070, the share of pension expenditure in GDP would be 0.3 percentage points higher, with an unemployment rate of 7% instead of 4.5% and labour productivity growth of 1.0%. The ratio between the number of contributors and pensioners would increase pension expenditure as a proportion of GDP by 0.3 percentage points, while the relative pension would decrease it by −0.04 percentage points.
Sources: COR projections – September 2022.

With regard to demographic assumptions in the first analysis, the migration balance assumption for the entire projection period and the fertility assumption for the second half would have effects primarily on the number of contributors, while mortality assumptions would have an impact mainly on the number of pensioners. In the short-term, migration variations result in a higher or lower number of contributors and the additional or non-existent net inflows would have an effect on the number of pensioners only after 20 to 30 years. The number of contributors would be higher (lower) in the case of higher (lower) fertility from the time that the first generations affected by this assumption reach the age of entry into the labour market (around 2045), while the number of pensioners would be identical to that of the central scenario due to a structural effect (children born from 2020 onwards will not retire before 2070). Finally, if life expectancy gains were to grow faster than expected, the number of pensioners would logically be higher than in the baseline scenario, as a result of a longer retirement period.

The migration balance and mortality assumptions also have an effect on the average pension. The effect of migration balance assumptions is small and depends on career length: immigrants generally have shorter contribution periods and therefore lower pension levels. In terms of mortality, a higher (lower) life expectancy, and therefore more (less) late deaths, results in a higher (lower) proportion of older pensioners among all pensioners. Since the pensions of older pensioners are lower on average, the higher number of pensioners with high life expectancy is associated, due to a composition effect, with a lower average pension for all pensioners, and vice versa. On the other hand, the relative pension is not mechanically affected by fertility assumptions since the higher (lower) number of people born will not have retired yet.

As regards the economic assumptions (productivity and unemployment), productivity assumptions have no structural effect on the ratio between the number of contributors and the number of pensioners, because they are based on the same demographic scenario and the same unemployment rate. Higher or lower unemployment, for its part, mechanically results in a lower number of contributors. However, the unemployment assumption also has an indirect effect on the number of pensioners, which depends on behaviour in relation to taking retirement, which varies according to the labour market situation at the end of peoples' careers.[20] The level of the unemployment rate also has an effect on the relative pension. On the one hand, if people extend their careers, their pension amounts are higher. On the other hand, more frequent periods of unemployment result in lower acquired pension entitlements, even where solidarity mechanisms (validation of quarters and free points in supplementary schemes) exist to mitigate the impact of unemployment on the pension amount (Cheloudko *et al*., 2020)[21]. However, the impact of unemployment on the pension of those covered by the scheme, and thus on the projected average relative pension, increases slowly and only becomes noticeable in the very long-term. However, the scale of these differences is much smaller than that related to differences in productivity growth assumptions, as they stabilise when the unemployment rate reaches its target value in 2032, while differences related to productivity assumptions are cumulative until the mid 2050s, as discussed in Section 2.

5. The Standard of Living of Pensioners Would Rise Less Than That of the Population as a Whole

The objective of financial sustainability of the pension system is accompanied by an objective of ensuring a satisfactory standard of living for pensioners. In order to assess whether this objective is met, beyond the pension related to income from employment, it is also necessary to take into account the other components of a household's standard of living. In addition to pensions, other sources of income must thus be added, first among which is income from wealth, which is higher for pensioners than for the population as a whole, since pensioners have a higher level of wealth on average (Secrétariat général du Conseil d'orientation des retraites, 2021). The redistributions that take place between households through the payment of benefits (other than pensions) and social security and tax levies must then be integrated. Finally, household size should be taken into account, which varies over the course of life. Pensioners' households are thus composed of fewer people than working households, in particular because children have generally left the home by retirement age.

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20. People covered by the scheme who are no longer employed at the time of retirement have no incentive to leave beyond the full rate, while people covered by the scheme who are still employed may choose to benefit from additional entitlements in return for a later retirement.

21. This mitigation is nevertheless partial. Firstly, these arrangements most often concern compensated unemployment. However, a significant proportion of unemployed people are not compensated and therefore cannot benefit from them. Secondly, there is no wage added to the account in the basic schemes of private sector employees: the longer the period of unemployment or the more periods of unemployment in their career, the greater the risk of having at least one year without a wage in the years taken into account for the calculation of the reference wage.

Since 1996, the standard of living of pensioners has been very close to (or even slightly higher than) that of the population as a whole, whereas it was 30% lower in the 1970s (Figure VI). The first reason for this convergence of living standards is the widespread application of the pension system introduced in 1945[22] and the continuous improvement of entitlements. The Boulin laws of 1970 following the Laroque report thus increased the rate of pay out and the reversion rate and minimum pension levels were established; the application of supplementary schemes was broadened and their contribution rates were increased, generating higher entitlements; contributory pensions and the minimum old age pension underwent significant increases until the mid-1980s. At the same time, careers, especially those of women, have become increasingly comprehensive, which has also increased the level of pensions. Finally, the increase in wage labour among the employed population has also contributed to the increase in pensions, with pension amounts being higher in schemes for employees than for non-employees (Aubert, 2023). Between 1996 and 2010, the average standard of living of pensioners rose in parallel with that of the working population and the population as a whole, but has since developed less favourably, particularly as a result of the smaller increases and the spread of tighter pension calculation rules (cf. Section 2).

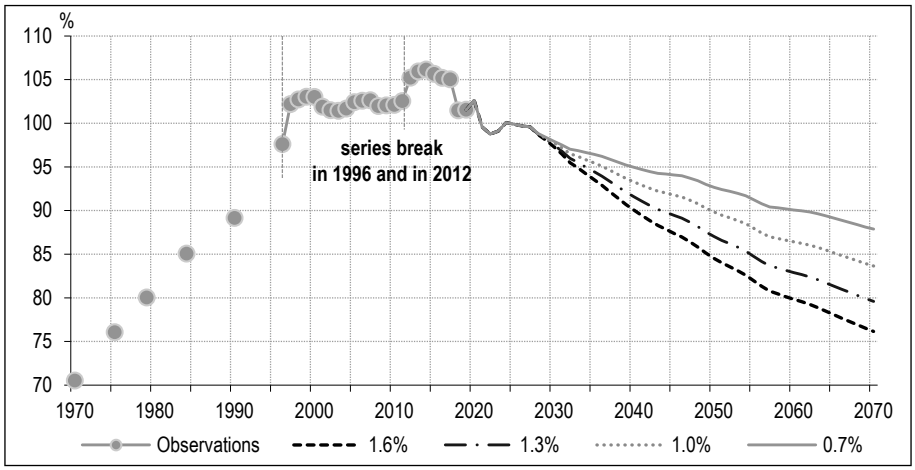
In the future, the relative standard of living of pensioners would largely depend on the development of the average pension relative to the average income from employment, as it is assumed that the proportions of income, social security and tax levies and wealth in household income would be stable. It would thus decrease to a greater extent as productivity gains would be important. Between 2021 and 2070, pensions would increase (ranging from increasing by 8.4% for the 0.7% scenario to increasing by 29.3% for the 1.6% scenario), but would do so slower than earnings from employment (increasing by between 40.3% and 102%), which would benefit fully from productivity gains.

The relative standard of living of pensioners would thus vary between 76.2% (1.6% scenario) and 87.9% (0.7% scenario). It would therefore reach values comparable to those it had in the 1980s or those found in many European countries (Belgium, the Netherlands or the United Kingdom, for example).

Moreover, the projections presented here are "mechanical" in the sense that they do not incorporate any changes in behaviour caused by the relative decrease in pensions: people covered by the scheme are assumed to continue with the same savings and pension pay out behaviour (retirement on achieving the full rate) in the future as observed at present. However, if they consider that the amount of their future pension is insufficient, people covered by the scheme

22. Extension of schemes to all professions and introduction of supplementary schemes.

Figure VI – **Relative standard of living of pensioners, observed and projected (average standard of living of pensioners relative to that of the population as a whole)**



Notes: The old Revenus fiscaux surveys (tax income surveys) were conducted approximately every five years from 1970 to 1996. The income measured in these old surveys is not directly comparable to the income measured in surveys conducted from 1996 onwards, hence the series break in 1996.
Reading note: In 2019, the last year observed, the average standard of living of all pensioners represented 101.5% of that of the population as a whole.
Coverage: All ordinary households.
Sources: INSEE-DGI, Tax income surveys 1970 to 1996; INSEE-DGI, Tax income surveys backcasted from 1996 to 2004; INSEE-DGFiP-CNAF-CNAV-CCMSA, Tax and social incomes surveys from 2005 to 2019; COR projections – September 2022; INSEE, DESTINIE model.

could – in so far as they are able – react to the relative decrease in pensions through two methods: either, for those whose income from employment so allows, through increased efforts to save for retirement during their working life; or, if they are in employment before pay out, by postponing their retirement age beyond the age at which they obtain the full rate.

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This article aims to provide information to frame the financial outlook of the French pension system for 2070 and the development of the standard of living of pensioners.

Despite the gradual ageing of the French population, pension expenditure as a proportion of national wealth, which synthetically expresses the level of levies that must be made on the wealth produced by the labour force to ensure the equilibrium of the system, would remain contained or would decrease, according to the labour productivity growth assumptions. This result may seem counter-intuitive in view of the expected ageing of the population, which will inevitably impact on future pension expenditure by increasing the number of pensioners relative to the number of contributors. This unfavourable demographic development is offset, firstly, by the increase of the retirement age from 62 years old to 64 years old due to the reforms already adopted and, secondly, by the lower increase in the standard of living of pensioners compared to that of working people. Due to measures taken in recent years by the various schemes and their extension into the future, the average pension would continue to grow in constant euro, but slower than average income from employment. The standard of living of pensioners relative to that of the population as a whole would thus be between 76.2% and 87.9% in 2070, compared with 101.5% in 2019.

The level of the balance is highly sensitive to the economic scenario chosen, since that largely reflects the sensitivity of the share of expenditure in GDP to labour productivity growth assumptions. It can also differ greatly, depending on the convention selected for the projection of resources. These differences are due to the fact that, depending on the conventions, the State contributes more or fewer resources to the pension system, even if the overall situation of public finances is equivalent under all the conventions.

To appreciate the respective merits of a given convention, it is not a matter of asserting that one is more "true" than another (all are conventions) but of measuring their pedagogical contribution to the understanding of the mechanisms underlying the pension system. Thus, as the CSR points out, behind the choice of one or the other of the conventions, there are different visions of what can or should be the overall effort of the nation in favour of pensions, expressed by pension expenditure as a proportion of GDP.

Either the projected share of pension expenditure in GDP and, as a corollary, the relative standard of living of pensioners and their length of retirement are considered adequate by the community. In this case, assuming that State contributions remain constant as a proportion of GDP (EEC Convention) and under the most favourable scenarios, projected surpluses after 2035 indicate the level of resources that can be redeployed to other social challenges or public policies, such as the climate transition. The funding needs identified under the EPR convention indicate, in contrast, the level of additional resources to be provided to the pension system by the labour force if the projected level of expenditure is considered adequate by society.

Or the projected share of pension expenditure in GDP does not seem acceptable to the community. If it is considered too low, then the surpluses identified under the EEC convention can be used to improve the relative standard of living of pensioners and/or their retirement period. If it is considered too high, then reforms can be envisaged to lower it by taking further action in respect of the decrease in the relative standard of living of pensioners and/or the increase in the retirement age. In this case, the convention corresponding to the current legislation (EPR convention) makes it possible to assess the extent of the adjustments to be made for the pension system as a whole. □

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Economie et Statistique / Economics and Statistics

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Les propositions d'articles, en français ou en anglais, doivent être adressées à la rédaction de la revue (redaction-ecostat@insee.fr), de préférence en format MS-Word. Il doit s'agir de travaux originaux, qui ne sont pas soumis en parallèle à une autre revue. Un article standard fait environ 11 000 mots en français (y compris encadrés, tableaux, figures, annexes et bibliographie, non compris éventuelles annexes en ligne). Aucune proposition initiale de plus de 12 500 mots (11 500 pour les soumissions en anglais) ne sera examinée.

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- Un fichier anonymisé du manuscrit complet (texte, illustrations, bibliographie, éventuelles annexes) indiquant en première page uniquement le titre, le résumé, les codes JEL et les mots-clés.

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Economie et Statistique / Economics and Statistics publishes articles covering any micro- or macro- economic or sociological topic, either using data from public statistics or other sources. Particular attention is paid to rigor in the statistical approach and clarity in the concepts and analyses. In order to meet the journal aims, the main conclusions of the articles, as well as possible limitations, should be written to be accessible to an audience not necessarily specialist of the topic.

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- A one-page file providing: the title of the article; the first name, name, affiliation-s (at most two), e-mail et postal addresses of each author; an abstract of maximum 160 words (about 1050 characters including spaces), briefly presenting the question(s), data and methodology, and the main conclusions; JEL codes and a few keywords; acknowledgements.
- An anonymised manuscript (including the main text, illustrations, bibliography and appendices if any), mentioning only the title, abstract, JEL codes and keywords on the front page.

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