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# Interest Charges and the "Said" Ageing-related Expenditures: A Study of OECD Countries

Zapji Ymélé Aimé Philombe[1]

*Department of public finance and taxation, University of Mons/Belgium, https://orcid.org/0000-0002-1509-4754*

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ABSTRACT

**Purpose**:
The main objective of this paper is to evaluate whether the interest charges on public debt could be a threat for the "said" ageing expenditures. This study attempts to analyze the effects of debt burdens known as interest charges in relation to the pensions and health care spending. The "said" ageing expenditures since the debate on this issue doesn't allow us to say that these expenses are totally linked to ageing.

**Design/methodology/approach:**
This study conducts an ordinary least squares analysis based on panel and cross-sectional data covering the period 2000-2020. The data are extracted from OECD statistic and from Eurostat statistic database. The research performs an analysis on 33 OECD countries. The dependents variables are pensions and health care spendings on GDP. The key independent variable is the interest charges. Other additional variables are included in the analysis that we can find in the text.

**Findings:**
The results of this study remain ambiguous and call for further study. Nevertheless, based on the current data, there is every reason to believe that, at present, expenditures on interest charges would not crowd out spending on pensions and health care. However, the significance of the demographic variables (old-age dependency ratio, total dependency ratio), and the increase in these ratios in the projections, point to a potential risk of collapse of the pension and health care systems.

**Research limitations/implications:**
The main difficulty encountered in this study was the collection of empirical literature dealing with our topic. Many papers used in our empirical literature was not always in relation with the topic of our research. Our challenge was to create the relation with those analyses to propose something original.

**Originality/value:**
We propose an innovative study, by proposing the analysis of debt charges in relation to pensions and health care expenditures. Several approaches in the same direction have used other parameters to analyze the costs of ageing, notably the debt to GDP ratio. We integrate other demographic variables such as the dependency ratio, macroeconomic indicators such as the savings rate. All these elements constitute the originality of our study.

## 1. Introduction

The ageing of the population has a growing concern both in the western, and developing countries; its repercussions, similarly, are regarded as of a central debate in recent public policy debates. In fact, the challenges related to the care of the elderly and the generational renewal imply a thorough reflection of the scientific, political and economic worlds. In this context, we are interested in the scientific and economic aspects. The public services associated with ageing are considerable in the advanced countries and involve pension schemes, health care systems, and to some extent education. Their management is primarily a matter for public choice, and finance, as the associated expenditures must provide the most efficient services without compromising current economic outcomes, and the budget sustainability. It is then a matter of resorting to the sustainability of fiscal policy. Moreover, Gruson (2018), emphasizes that fiscal sustainability, in other words the sustainability of fiscal policy, accounts for the state's capacity to ensure the payment

[1] Corresponding author: Zapji Ymélé Aimé Philombe
Email: aimephilombezapjiymele@gmail.com
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of financial charges and to meet the costs of the action programs it has undertaken. Closely related to this, Auerbach et al. (1989), suggest that fiscal policy is efficient if it is able to generate enough revenue to meet or repay the accumulation of debt and associated interests. In the long term, it is a question of looking at the intertemporal budget constraint. Indeed, the challenges faced in relation to ageing are projected over several decades. Experts in the field watch over the data world and European level, or even in Belgium through the Study Committee on Ageing. Thus, in the latest 2021 report of the latter, mandated by the Belgian High Council of Finance, and based on the analyses of Statbel (Directorate-General for Statistics) and the Federal Planning Bureau, it stresses that the costs associated with ageing are increasing as is the elderly population. This conclusion is in accordance with similar observations of European experts and the OECD. If there is one thing that everyone agrees on, it is that age-related expenditures will lead to burden that, if left unchecked, could cause public policy disasters. Experts in the field see several impacts, including fiscal, macroeconomic and social impacts. On the fiscal side, for example, Auerbach et al. (1989), Afflatet (2018), Chen (2004), Ramos-Herrera and Sosvilla-Rivero (2020), Adb Rahman et al. (2021), to name but a few, have shown that fiscal policy will be impacted due to the fiscal imbalance that might be incurred. As pensions are the largest share of the ageing population public expenditures, Grech (2013), Zaidi (2010), as well as many other authors have focused on the sustainability of pensions showing that it is important to pay special attention to reforming the pension systems.

On the other hand, health and long-term care expenditures, although discussed, are also an important part of the burden on public finance. In fact, research by Newhouse (1977), and Dormont et al. (2006), does not show a certain impact of age-related health expenditures on public spending more than other sectors of economic activity. However, Lindgren (2016), and Propper (2005), point out that ageing is also about long-term life support. Since this category of the population very often uses long-term care, it would be wise to carry out an additional study on the additional costs related to long-term care for instance.

In addition, on the macroeconomic level, Disney (1996), Turner et al. (2005), Weil (2006), warn that the decline in productivity linked to ageing would lead to a decline in savings. If this stands true, resources needed for investment would also take a hit. As a trigger, it might compromise economic growth if there should not be any long-term solution found. In fact, economic growth, being the engine from which revenues are generated to finance these costs, could be impacted by this low productivity. States would be faced with an increased debt constraint in order to bridge the income gap.

Debt liabilities imply the repayment of debt and the resulting interest charges. Interest charges are both a cause, and a consequence of public indebtedness. It reflects the burden born in terms of maturing debt repayment, and the associated interest charges, generally expressed as a percentage of GDP. In our previous work, we showed that interest charges, if not controlled, could undermine the sustainability of public finance. In the long run, these charges could prove to be depletive to ageing-related expenditures, hence our study examines whether interest charges can have a crowding out effect related to ageing expenditures. If there is any evidence these days, it is that interest rates on financial markets are relatively low in OECD countries, leading to a reduction in interest charges. This would suggest that the average interest charges in these countries have shrunk in the recent years. We may expect, accordingly, that it provides a relief, or rather a margin for OECD countries to cope with the increased ageing-expenditures projections. However, answering this question requires us to work on OECD countries and by the ordinary least squares method on panel data and on cross sectional data covering the period 2000 to 2020, before giving an answer. Our dependent variables in this study are pensions and health care expenditures as a percentage of GDP. The objective of this paper is then to evaluate whether the interest charges could be a threat for the "said" ageing expenditures. The aim is to propose something innovative by proposing a study that analyses interest charges in relation to the "said" ageing expenditures. Insofar as most studies analyze other fiscal variables such as the public debt.

The rest of the article will be organized as follows: Following this introduction, a second part will focus on the issue of ageing. Starting with a general definition, we will outline the contours of ageing before highlighting its link with fiscal policy. A third part will review the literature on the effects of population ageing. A fourth part will then make an empirical study of our research question. A fifth part will conclude our work.

## 2. The issue of ageing

### 2.1 synthetic definition

Although the ageing of the population has become an important issue in debates between politicians and researchers, it is essential to clarify the concept before any analysis. Légaré (2009), informs us that the ageing of individuals is primarily biological and leads to death. It is the process of genetic transformation of man from birth to death. It is ultimately a biological definition and relates to the singular aspect of the individual. On the other hand, when we talk about the ageing of the population, it is strictly structural, the author continues. Several approaches have been proposed to define population ageing, also called demographic ageing. Chen (2004) presents population ageing as a demographic phenomenon that results in an increase in the percentage share of older people in the total population. This tendency is explained by lower mortality rate because of improved well-being, including health care, which accounts for a high proportion of the elderly, and an associated longer life expectancy. The latter is completed by Chesnais (1986), quoted by Légaré (2009), who tells us that it is the decline in fertility that causes the ageing of populations. To understand this phenomenon, we believe that in the early days of technological progress, medical progress first tackled and succeeded in overcoming infant mortality, resulting in younger populations. Then, as mortality, rates were very low, reductions in adult and old age mortality because of improved living conditions and

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health care took over gradually led to ageing populations. Demographic ageing is therefore the slowing down of the birth rate and the death rate, which leads to an increase in the proportion of elderly people, or the average or median age of the population. The approaches used to analyze ageing are threefold: population life expectancy, fertility rate and net migration. Population life expectancy simply refers to the average length of human life in a given society. It has increased considerably in recent decades due to advances in medical care that have enabled young children to survive into adulthood. On the other hand, thanks to improved nutrition and other medical advances, more and more people are living to advanced ages (Melyn et al., 2016). The fertility rate reflects the average number of live births in a year to women of childbearing age. For example, between 1946 and 1970, the number of children per woman was 2.7 in OECD countries. Today, the average number of children per woman is estimated at 1.7 in Belgium, for example. Net migration is another important component in changing the age structure of the population. It is defined as the difference between the number of immigrants and the number of emigrants (Melyn et al., 2016).

**2.2 Measuring demographic ageing**

Studies on demographic ageing have found the dependency ratio to be the determining factor in assessing the impacts of the demographic transition. The old-age dependency ratio, according to the OECD (2018), can be defined as the number of people aged 65 and over per 100 people of working age, i.e., people aged 20-64. This ratio varies over time and among countries. Indeed, in the 1980s, this ratio was 60 years and over for the working population aged 18-60. The low life expectancy at that time could explain this criterion. In addition, in some countries such as Canada, this ratio is analyzed in the 15-64 age group. In fact, the working population ranges from 15 to 20 years old in some countries. However, whatever scale is taken into account, it is that this ratio tends to increase in many countries. The increase or decrease in this ratio, again according to the OECD, depends on mortality and fertility rates and net migration. Between 1946 and 1970, the number of children per woman was 2.7 in OECD countries. Today, this figure is continuously declining. This shows that over time women have on average less children than their mothers, probably due to long studies and career ambitions. On the other hand, the annual net migration according to Melyn et al. (2016), in Belgium, has increased from about 15,000 in the 2000s to 65,000 in the 2008-2011 triennium and this is in line with the OECD countries. There are several reasons why the dependency ratio is important in the analysis of ageing. Nicoletti and Hagemann (1989), insist on this ratio because the fertility rate is particularly unstable. Mortality, on the other hand, is certainly more stable in the medium term, but it too can be difficult to anticipate, given the impossibility of foreseeing any major advances in medicine. Moreover, as changes in lifestyles and health care in the early years of life may affect longevity in ways that remain uncertain, life expectancy may deviate significantly from the figures used in the projections. Immigration, which is strongly affected by political as well as economic factors, is also very difficult to predict, the authors continue. Life expectancy has increased considerably in most rich countries, a trend that most analysts predict will continue, implying an increase in the number of older people and probably in the number of pensioners. This is a wake-up call because its effects are both social and economic. In addition to the ever-increasing life expectancy, the fertility rate has tended to fall, leading to lower figures regarding the entry of the youth into the labor market in the near future. The renewal rate is thus reduced. Some countries that have a favorable trend towards immigration will see this dependency ratio mitigated because the immigrant population will fill the gap of the fertility decline. This is notably the case in Canada, Australia and the USA. In the long term, according to demographic studies, all OECD countries will converge towards an increase in this dependency ratio. Moreover, it can be noted, for example, that in Belgium the dependency ratio has risen sharply since 1950. It was 18.1% in 1950, rose to 25.2 in 1975, 28.3 in 2000 and 30.6 in 2015. It will be 37.1% in 2025, 51% in 2050 and 54% in 2075 if nothing is do. The following table gives an idea of this ratio in some OECD countries in the period 2000 to 2020.

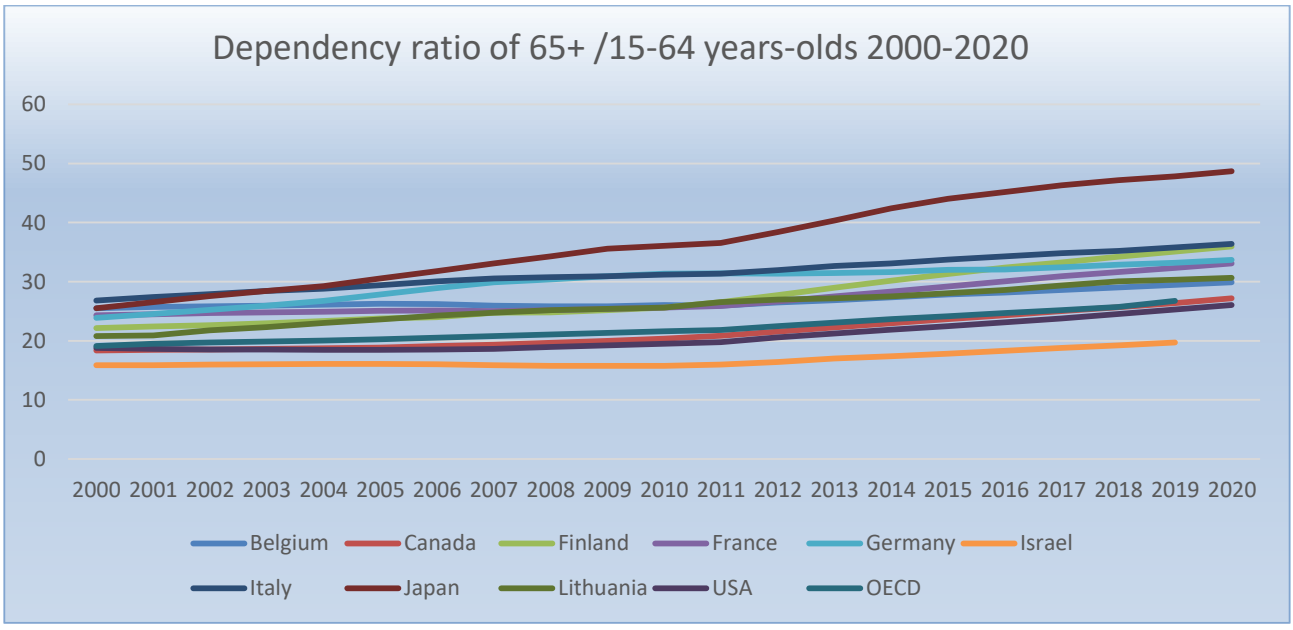

**Figure 1: Old age dependency ratio**
Sources: Data from OECD statistics, graph by us (Author's construct, 2023).

From the graph above, we can see that there is a tendency for this ratio to increase in the selected sample. It is certainly true that this ratio manifests itself to different degrees, as in the case of Japan, which is already experiencing a concrete manifestation of population ageing. In 2020, this ratio will reach almost 50%. On the other hand, some countries have this ratio fairly contained. This is the case of Israel, which has a ratio of less than 20%. For the rest, this ratio is concentrated between 20 and 30%. Moreover, the OECD average is around 20%.

Although it is recognised that the dependency ratio is unanimously accepted in the scientific world in the study of ageing and its social and economic consequences, other authors have had the merit of providing some criticism. According to Gauthier, H. (1982), in addition to the dependency ratio, other economic criteria should be taken into account, such as participation to the labour market, government spending and all private and future consumption. The idea behind labour market participation is the analysis of the inactivity rate, which determines the share of the population participating in production and income. That is, the more active people there are in a population, the higher the per capita income, taking into account the productivity and employment conditions of the labour force (United Nations, 1969), quoted by Gauthier, H. (1982). Thus, if housewives, the long-term unemployed and all other inactive people are included in the working population, it is clear that there are limits to the dependency ratio. Furthermore, the same author continues, spending on the young and the old are distinct in that, for example, spending on the young is lower than spending on retirement or health care. Despite the limitations that emerge, we believe that the dependency ratio remains the best option for studying population ageing. However, in some works other forms of analysis are proposed, such as the youth dependency ratio, which measures the number of 0-19 years old out of the active population aged 20-64. The total dependency ratio is also proposed. It reflects the total 0-19 and 65+ years of age out of the 20-64 year old working population. Other analysis criteria have been proposed, in particular the dependency ratio of senior citizens, i.e. 80 years and over, which can also be taken into account in the study of ageing. This is because this segment of the population is increasing over time and its impact would appear to be more marked in the evaluation of health care expenditures.

### *2.3* Demographic ageing and fiscal policy

The analysis of ageing and its relation to fiscal policy is based on five main sectors: Pensions, health care, long-term health care, education and training. In our work we will focus on the analysis of pensions and health care. Pension funding is an important part of public expenditures, accounting for up to a third of total expenditures in many OECD countries. Pensions are most often provided in two forms: pay-as-you-go and funded systems. The pay-as-you-go system has several advantages: it allows pensions from contributors to be paid immediately to beneficiaries; it avoids the risks that inflation might pose to pensioners by linking future pensions to nominal wages. It can provide a higher rate of return to each generation if the sum of the rate of increase in the working population and the rate of increase in wages exceeds the market rate of interest Hageman and Nicoletti (1989). However, it has some drawbacks. It does not in itself increase the volume of resources with which pensions are paid; there is only a transfer of purchasing power from one group (working people) to another (pensioners). Also, it could, if necessary, discourage saving, thus reducing the capital stock from what it would otherwise have been. In the long run, the state will always have a "stock" of uncovered liabilities. This is because the present value of its future pension obligations always exceeds the present value of its future income from existing generations. This leads to debts and deficits. In the funded system, the premiums charged to the insured group (i.e. future pensioners) are set so that the present value of all contributions (past and future) paid by the group is equal to the present value of the future expenses generated by the group. It has the advantage that it can, by inflating the volume of aggregate savings, increase the capital stock and the future level of output. Further, contributions to a funded pension scheme are unlikely to appear to contributors as a tax. The disadvantage usually put forward is that pensions are paid out of the funds and interest paid in, and it becomes difficult to contribute at the full rate as it will take several years. Also, the existence of a very large fund may in itself lead to an increase in the level of government consumption or an increase in the benefits provided to current recipients of public transfers. Many countries are now adopting a bit of both systems to meet pension expenditures.

Health care is also a challenge for public finance. This expenditure can sometimes be equivalent to 10% of GDP in OECD countries and that of long-term care to 1.5%. Indeed, the evolution of the elderly population is often assimilated to an additional cost of health care expenditures, particularly long-term care. However, the debates around this issue tend to favour those who tend to minimise the impact of ageing in relation to care costs (see the work of Hélène Dormont). For the latter and others, the costs of health care evolve with the demand for care, the technology applied and the costs of care personnel. Below we have an idea of the expenditures on health care in a sample of 10 OECD countries.

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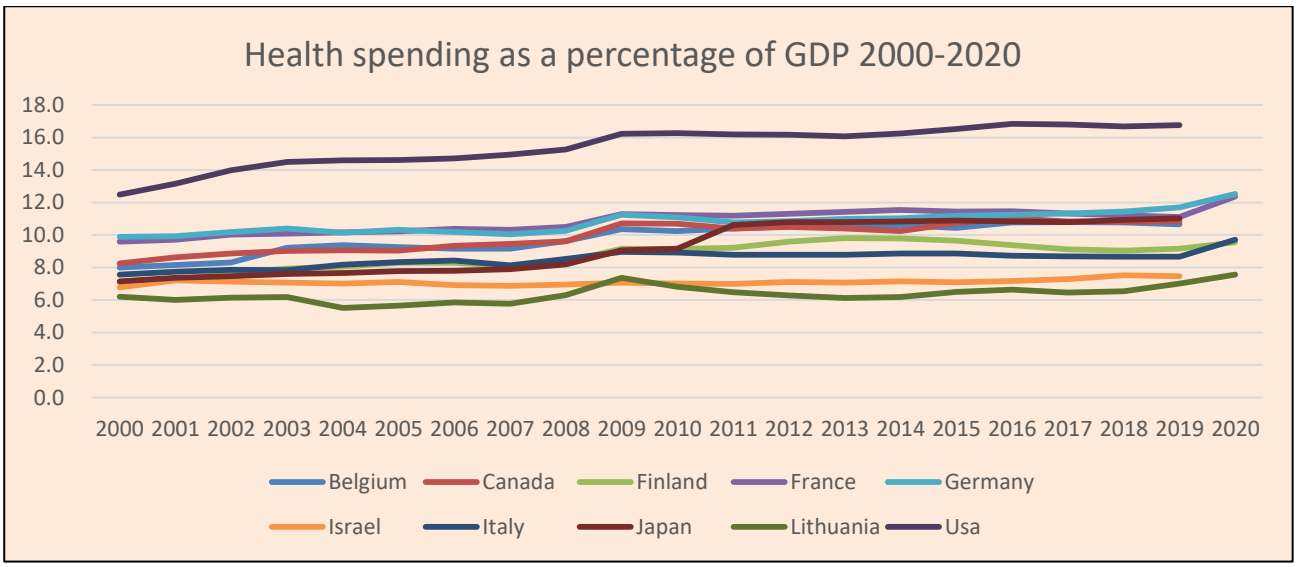


**Figure 2: Health care expenditures**

Sources: Data from OECD statistics, graph by us (Author's construct, 2023).

The chart above shows that in the OECD countries, at least in our sample, health care spending has tended to stabilise from the 2000s to the present. Only the United States has experienced growth during this period. While in 2000 spending on health care represented 12%, by 2020 it was estimated to be over 16%. This may be due to GDP growth or it may be due to spending on technology and health care personnel. The country with the lowest expenditures on health care is Lithuania, which is around 8%. Countries such as Belgium are in the middle of the two above-mentioned countries and their expenditures has increased slightly since the 2000s to reach 10% of GDP.

## 3. Literature Review

The analysis of the sustainability of fiscal policy in relation to ageing is a vast field of research for many authors. As we have already stated above, the challenge of population ageing lies in pension benefits, health care and education. Here we will focus on the first two aspects.

The ageing of the population due to an improvement in living conditions brings with it the additional cost of caring for the social categories concerned. The challenge for Western states is to maintain a decent standard of living while keeping budgetary policies viable in the long term. In this respect, Chen (2004), tells us that an unexpected increase in the share of the elderly in the population due to improved longevity tends to increase the budget deficit. This is because it increases the amount of social security benefits that are paid to the elderly by the government. These social benefits, which are financed by taxes and social security contributions, are collected from the working population. If the dependency ratio increases, as is the case in many countries, the situation will be more problematic in the coming decades. Hayati Abd Rahman et al. (2019), make the same point. As the population ages, the number of workers decreases, if there is no change in policies (increase in pension contributions, increase in taxes or reduction in expenditures) this will lead to pressurised public finance. The need for funds will thus force policy-makers to chose indebtment to cover deficits and the associated debt charges. Jensen and Nielsen (1995), confirm this by adding that until the ageing process takes place, if fiscal policy involves a constant debt-to-GDP ratio and balanced budgets, the generations that become old during the ageing period will hardly feel the ageing process. On the other hand, the general tax burden of those who are working at the time the process is underway will be subject to taxes that will increase in line with the increase in old age-related expenditures. Langenus (2006), in order to face both the challenges of ageing and public debt, proposes pre-financing. This would make it possible to relieve current workers and those of successive generations and thus make it possible to achieve the intertemporal budget constraint. The author argues that public finance need to be put on a sounder footing by consolidating them more effectively, which will improve net assets. The creation of net assets will facilitate job creation and productivity, which are the driving force behind the improvement of the primary balance important in pre-financing the costs of ageing. These measures would help to avoid additional pressure, as Hageman and Nicoletti (1989) point out. Excessive pressure encourages the relocation of companies and workers to other countries where the tax pressure is lower. This makes the system in the country of these workers even weaker. For the author, if we have to wait until the moment when public debt accumulates to set up policies, it would be too late and all this would create distortions for those who will be active. If Trandafir Adina (2017), informs us that the sustainability of public finance, which is the capacity of a government to support long-term expendituress without increasing public debt, is threatened, it is nevertheless a question of maintaining the intertemporal budget constraint. For this reason, Cristescu (2019), shows that social sustainability must take into account the risk of poverty of the elderly. This is to remind policy makers that ageing reduces the capacity to work, which in turn reduces income and thus the capacity to save. This will require public finance to find mechanisms to take care of these people. As the dependency ratio is constantly increasing, as the latest publication of the European Union's Ageing Working Group (AWG) reminds us, public deficits and debts and ipso facto interest

charges could increase significantly. Is it not therefore fundamental to take into consideration the sustainability of pension systems?

The analysis of pension systems is a crucial aspect in the analysis of ageing as it entails huge burden and therefore needs to be handled with care. Schneider Cesifo (2009), speaking about pension reforms in Europe, considers that a pension reform is considered successful if it reduces future expenditures. In other words, the sustainability of a pension system lies in its capacity to reduce benefits, especially pensions. This view that pensions are expensive for public finance and should in principle be reduced to avoid excessive burden on future generations is challenged by Grech (2013). For him, pension plans should integrate three factors, namely, public expenditures, pensioner poverty and the level of income replacement. Therefore, cutting expenditures should not be considered as the right answer to ageing. A system should be able to guarantee benefits to the whole population to prevent old age poverty and offer ways to smooth consumption over the life cycle. This means analysing situations on a case-by-case basis. Indeed, as already suggested by the OECD (2005), quoted by Grech (2013), a country with a lower life expectancy could afford to pay higher replacement rates to its citizens while imposing the same contribution on its workers as a country with a higher life expectancy. This is in line with the idea of the public support ratio analysed by Lee and Mason (2016). Where they show that the analysis of expenditures that integrate the pension system should include the public support ratio. If the public support ratio is around 1, the primary budget is balanced and no sphere of society (workers and pensioners) should be under pressure. However, if the ratio is below 1, benefits may have to be reduced or taxes increased. Similarly, if this ratio is higher than 1, it means that benefits can be increased or taxes can be reduced without affecting the budget balance. The answer to the question of the future of pensions in the face of ever-decreasing fertility rates has been a leitmotif for some authors. In this context, the work of Oksanen (2009; 2016), has made it possible to examine the notion of generational equity in the design of pension reforms. To this end, he assumes that if the incoming and outgoing generations are balanced, i.e. the young contributing for the old, there would be no worries. However, if the current generations have a lower birth rate, it makes sense to increase pension contributions, thus increasing savings and capital, or to raise the retirement age in order to avoid a double burden on future generations. Should we not assess whether immigration could be a solution to the sustainability of public pensions as proposed by Serrano et al. (2011). Godbout et al. (2010), argue in the context of intergenerational equity to calculate in the projections, as was the case in Canada, the volumes of taxes and tariffs that will be required, uniform and constant from the year of projection until the next 50 years. The income earned would be set aside for a certain period of time and then later spent on new generations. Actuarial neutrality would then mean that the degree of pension funding would change in line with fertility, longevity and pension policy parameters. This implies that adults have to compensate for lower fertility and increased longevity by increasing their retirement age. A problem of equity could still arise. For this reason, Oksanen (2016), reminds us that while it is verified that the post-World War II generations have not contributed much to personal pensions, they have nevertheless contributed to the accumulation of savings and capital. And, taking into account the multiplier effects of economic growth, would it not be interesting to take this into account when evaluating pension reforms, as many experts recommend in Western countries. The replacement rate should therefore take this factor into account. Other recommendations for improving pension systems are offered by Van Meensel et al.(2016), Bazzana (2020), Van der Horst et al. (2011), Hageman and Nicoletti (1989) and D'Autume (2003), who emphasise reforms of both the pay-as-you-go system, which most OECD countries use, and the funded system. What emerges is a gradual increase in retirement ages. It would improve fiscal sustainability. Indeed, the extension of the active period is synonymous with additional budgetary revenues and less expenditures. Bazzana (2020), for example, teaches us that when the share of workers is higher than the share of retirees, the pension system is fully sustainable. Because the tax base is broadened, total output itself improves and thus resources are available to improve the state budget. This somehow helps to meet the challenges of ageing and to solve the problem of interest charges on the public debt. Also, the extension of the retirement age allows the distribution of the social burden among all social components. Indeed, when these burden rest on a few workers, the tax pressure on these workers is enormous, which will tend to discourage some from working, and since we know that a worker receives few transfers from the state (unemployment, health care, social security), it is preferable to encourage a large number to work and to stay at it as long as possible. In OECD countries where there is a slowdown in fertility, an increase in retirement ages would only be beneficial, as it would help to keep the demographic dependency ratio at sustainable levels. Also, reforms of the pension system should encourage greater participation of women in the labour market. Greater participation of women in the labour market reduces the number of dependents on the state, increases tax contributions and decreases dependency ratios. Hageman and Nicoletti (1989), would like the authorities to review pension replacement rates. Indeed, to receive a full pension, most systems do so on the basis of final gross earnings. Our authors propose, for example, to use net wages as a basis, which would make the pension system less generous.

Health care is a determining factor for social well-being. As such, it is one of the determinants of improved living conditions and is strongly associated with increased life expectancy. However, over time health care costs become considerable, and are rightly or wrongly attributable to advanced ages. In the literature reviewed, the works of Dormont (2010 and 2012), Dormont and Huber (2009), Dormont et al. (2006), are firm on the argument generally put forward concerning health care costs. For these authors, the increase in health care costs would not find its major explanation in ageing. It is true that individuals see their health expenditures increase with age, but the primary explanation is that as time goes by, individuals spend more on their health. In 1990, for example, an individual suffering from cancer would spend less than in 2020 for the same disease. Also, as people age they are more likely to develop certain diseases. Here it is primarily a question of biology. Thus, a person whose age changes should still have health concerns, and this would not be an additional cost to state health care spendings. Furthermore, the type of

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disease explains the cost of expenditures independently of age. Indeed, people with chronic diseases (e.g. renal failure) need periodic treatment, and incur recurent intervention financed through the healthcare system, and even if they are insured, the public intervention is more considerable given the technologies used in the case of renal failure for example. Co-morbidity factors are also another reason for soaring health costs. Although the proportion of the population mainly subject to co-morbidities (a set of pathologies) is found among the elderly, other social categories are also affected. As a result, people with several types of illnesses will naturally be less productive and will therefore have to be supported by the social system and this will further increase the costs of care. Tenand (2014), follows the same line as the previous authors, but adds the types of care as another reason for the costs. Indeed, once a disease has been diagnosed, the costs will depend on the treatments available and used, as well as the medical interventions that follow, including consultations, examinations and the type of clinic, to name but a few. The costs of care are to be found in the years before death. The previous authors have shown that the closer one gets to death, the greater the costs become. If we refer to palliative care units, it is clear that these patients are being cared for with enormous resources, including drugs, real estate and the cost of nursing staff. Technological progress necessarily plays a major role in increasing or reducing these types of costs. Newhouse (1977), already argued that health technologies play a minor role in increasing health care costs and his ideas have been the subject of other studies, such as Westerhout (2006), who highlighting the elements presented above, analysed the role of technological development in health care. It is clear that while technological development lower costs in some sectors, it does the opposite in the health sector in different situations. Dormont (2009), mitigates this by pointing out that the diffusion effect (the nature of the innovation of new treatments to a greater or lesser number of patients) leads to an increase in expenditures, while the substitution effect (i.e. new treatments replacing others) leads to a decrease in costs. However, the explanation for the growth in the costs of technological innovation is largely due to patents, the costs of training health professionals and of course public policies in this area.

At the macroeconomic level, the effects of ageing are manifested in particular on capital and savings. Dave Turner et al. (1998), report that in OECD countries, the decline in savings in the future seems to be confirmed. Whether it is private or national savings, this reduction will put upward pressure on real interest rates, which in turn will lead to a slowdown in capital accumulation. Being strongly linked to capital, investment would be reduced and this will influence the growth of the economy and therefore the overall wealth. To understand the macroeconomic impact, we start from the analysis of the life cycle of the saver proposed by Disney (1996). Indeed, the slowdown in savings linked to ageing stems from the fact that in the human life cycle, savings are high when people are working and they are therefore net savers at that time. As he ages, he gradually exits the labor market and becomes a dissaver. In macroeconomic terms, if the dependency ratio continues to be persistently high, it is easy to understand that the household savings rate will be lower. As Weil (2006) argues, capital accumulation allows individuals or society as a whole to break the temporal link between production and consumption, i.e. an individual, for example, can save part of his or her wage while working and then use the accumulated capital to finance consumption during retirement. Recent state reforms to raise the retirement age in line with increasing life expectancy serve to increase aggregate savings, reduce social security contributions and increase the tax base. Afflatet (2018), on the other hand, points out that the increase in the old-age dependency ratio leads to a decrease in the labor force which, in turn, should lead to a decrease in the growth rate. In the same sphere, he states with regard to interest rates, that it could be expected that older people entering retirement would deplete their savings, leading to a higher interest rate due to a reduced supply of capital. Baumol (1967), will propose an analysis of productivity by stating that the steady growth of productivity is the result of technological innovation manifested by new capital goods. Capital goods are thus the source of economies of scale, which is another source of productivity growth.

## 4. Empirical analysis

### 4.1 Synthetic empirical literature review

Population ageing has or will have effects on the sustainability of public finance. To analyse these effects from a scientific point of view, we need to look at some of the articles that will inspire our work. Here we propose a synthetic review which is however far from being exhaustive.

Ramos-Herrera and Sosvilla-Rivero (2020), analyse the effects of ageing on the sustainability of fiscal policy in 11 European countries covering the period 1980-2019, while controlling for macroeconomic variables (real economic growth, financial development, the inflation rate, the trade balance, the effective exchange rate, the output gap and, of course, demographic ageing). Working on panel data from Eurostat, the results of this study show that ageing has generated profound pressures on fiscal sustainability. With a negative and statistically significant coefficient, the budget balance deteriorates on average by about 21.30 percentage points for each percentage point increase in the old-age dependency ratio. Fiscal policy has therefore not been compatible with long-term sustainability.

Afflatet (2018), analyses the impact of population ageing on public debt. He works with ordinary least squares on panel data for 18 European countries covering the period 1980-2015, and these data are taken from Eurostat. In his analysis, it is shown that there is little empirical evidence of such an impact until 2015. He works with different indicators to capture the ageing of the population such as the total dependency ratio (0-15 and 65+/15-64), the old-age dependency ratio (65+/15-64), the over 85 dependency ratio (85+/15-64). It also inserts other macroeconomic variables such as per capita income, unemployment, investment and growth. The results for the demographic variables show that the total dependency ratio and the old-age dependency ratio are significant in reducing the debt. By splitting the dependency ratios of the under 85s and the over 85s, this result does not fundamentally change. The same is true for the dependency ratio of the under-15s.

Abd Rahman et al. (2020), analyse the external debt of states in relation to ageing. Other control variables are included in the model such as inflation, GDP growth, interest rates, gross debt. The latter use a panel of 36 countries between emerging and developing countries over the period 2000 to 2017. The data is taken from the World Bank's World Development Indicator and the International Monetary Fund's World Economic Outlook. They use the generalized method of moments (GMM), which shows that population ageing has generated a significantly positive relationship with the external debt of the IMU, but with a very small impact (between 0.058% and 0.063%) when the independent variable is the percentage of the population aged over 65. In contrast, the old-age dependency ratio did not show a significant correlation.

Cristescu (2019), using Eurostat data and an econometric study on panel data, analyses the effects of the risk of poverty among the elderly using ordinary least squares. She observes that some European countries will experience a demographic decline while others will be clearly spared. However, the cost to public finance will remain considerable whatever the scenario. Analysing the 28 European countries over the period 2005-2017, the sustainability of pensions is at the heart of his study. The results show that life expectancy is negatively correlated with the risk of poverty in old age. Also, the dependency ratio is positively correlated with the risk of poverty. Because the higher the dependency ratio, due to a reduction in the active population and thus a low entry of young people into the labour market, this puts additional pressure on fiscal policy. The same situation is true for the increase in health care costs. In fact, an increase in health care costs crowds out other expenditures such as pensions, which leads to an increase in the risk of poverty among the elderly.

Schneider (2009), analyses pension reforms in 17 member countries of both the OECD and the European Union based on panel data. He performs an ordinary least squares econometric analysis of the index of pension reforms on variables such as: trade union power, fiscal institutions, general government expenditures, pension expenditures, pre-funding of pensions, public debt and the demographic dependency ratio. The results obtained show a weak correlation between the demographic dependency ratio (significant at 10%) and pension reforms. The collective bargaining power of workers and current pension expenditures are largely significant (between 5 and 1%). Other variables such as public debt, the ratio of workers with pension funds and the change in pension expenditures are not significant.

Razin et al (2002), analyse population ageing and the size of the welfare state. The regressions elements are: the labour tax rate and real transfers per capita on the population dependency ratio. Additional control variables are introduced such as public employment, GDP growth and the degree of openness. Most of the data are taken from OECD statistics. The basic idea of the analysis is that states with a high tax rate are those states with the highest public transfers. Using an ordinary least squares econometric analysis in panel data, the authors conclude that the dependency ratio has a statistically significant negative effect on the labour tax rate, which removes the ambiguity of the analytical model. A one percentage point increase in the dependency ratio leads to an almost 0.4 percentage point decrease in the labour tax rate. A higher dependency ratio leads to lower transfers per capita, the coefficient being statistically significant in all specifications.

Chen (2016), conducted an ordinary least squares econometric analysis, where he deals with the effects of the age structure of the population and the budget deficit by analysing panel data with fixed effects. The data are estimated over the period 1975-1992. He analyses the population structure on the primary surplus by also including a lagged dependent variable to reduce the serial correlation of the error terms. The regression results indicate that an increase in the shares of the young population and the elderly tends to decrease the budget surplus shares only in developing countries. For developed countries, the author indicates that increases in the shares of the young and elderly population tend to increase the share of the budget surplus in GDP, with the estimated coefficient for the elderly population share being significant. Other variables such as the working population are naturally significant. Indeed, the more the population works, the more the state has the means to ensure its regalian missions.

Jochen Hartwig (2008), taking up Baumol's (1967) theory on the determinants of health expenditures, whose conclusions showed that health expenditures are determined by higher wage increases linked to productivity growth, which leads to a directly proportional growth of health expenditures. The author conducts an empirical study using ordinary least squares in cross-sectional and panel data on 19 OECD countries covering the period 1960-2004 and from 1990 to 2003 for France. The data are taken from the health section of OECD statistics. The variables analysed in his model include current expenditures on health care as the dependent variable, labour productivity, wage growth and real GDP growth as independent variables. The regression results indicate positive significance at the 1% level for labour productivity growth, real GDP growth and wage growth.

### 4.2 Selection of variables and models

As mentioned above, our study focuses on debt servicing in relation to the costs of ageing. The question is to see to what extent public debt charges are likely to crowd out the costs associated with population ageing. The literature analysed above has highlighted several important elements that could explain our problem. We will draw inspiration from them for the choice of our variables, for which there are no typical cases in the literature.

As mentioned above, our work focuses on the analysis of pensions and health care costs in relation to debt charges. We propose here the variables to be used in the first model. Naturally, our first dependent variable is the pension as a percentage of GDP (PENSION). In OECD countries, public pensions represent more than 10% of GDP, especially in Western Europe, as in Belgium, where they are expected to rise to 13% by 2021. Several authors have worked on the subject, such as Ondrej Schneider (2009), and Critescu (2019), and have shown that they have a considerable impact on fiscal policy. Our key variable is the burden on public debt as a percentage of GDP (DEBTCHARGE). It is closely related to public debts and therefore should have a considerable impact on social spending. We naturally integrate the demographic variables (DEM), the first element of which is the old-age dependency ratio (65+/15-64 years) defined

above. Subsequently, we will integrate the total dependency ratio (0-15 and 65+/15-64 years), the youth dependency ratio (0-15/15-64 years), the 65+ and 80+ populations into the total population. Other control variables are also inserted in our model. Thus, General Expenditures as a percentage of GDP (GENEXP) is associated with it. In the analysis of the sustainability of public finance, it is interesting to integrate the overall government expenditures, as it is expected to explain or at least have an impact on pension expenditures. The variable GDP growth (GDPGROWTH) is also inserted in our model. Working in the macroeconomic sphere, it is interesting to insert it because we believe that it would explain our dependent variable. Our model also incorporates savings over GDP (SAVING). Savings or capital is decisive in studies of this type as Disney (2016), alluded to. We have seen in the literature that it determines the potential capital to be invested and we believe that in pensions it would have an influence. In fine, we will insert the variable taxes (TAXES). In fact, in sustainability analysis, taxation is always put forward as a determinant of public expenditures because the financing of the latter depends on the former. Other variables will be inserted later in order to test the robustness of our model. Our model is presented as follows:

$$PENSION(i,t) = \beta 1DebtCharge(i,t) + \beta 6DEM(Rate\ 65+/15\text{-}64)(i,t) + \beta 2GdpGrowth(i,t) + \beta 3GenExp(i,t) + \beta 4Saving(i,t) + \beta 6ITaxes(i,t) + \mu(i,t). \quad (1)$$

As our work also focuses on the analysis of health expenditures in relation to public debt charges, we propose to distinguish two models to avoid misinterpretation. Health expenditures as a percentage of GDP (HEALTH) is our second dependent variable. Our key variable is public debt charges as a percentage of GDP (DEBTCHARGE). The choice of this variable is in line with the problematic posed above. Chen (2016), for instance, in his study uses primary surpluses to analyze sustainability, while Schneider(2009), uses public debt, to name but a few. We naturally integrate the demographic variables (DEM), the first element of which is the old-age dependency ratio (65+ / 15-64 years) defined above. Subsequently, we will integrate the total dependency ratio (0-15 and 65+ /15-64 years), the youth dependency ratio (0-15 / 15-64 years), the 65+ and 80+ populations into the total population. Other control variables are inserted in our model, notably GDP growth (GDPGROWTH). Here we are inspired by Hartwig (2008), Herwartza and Theilen (2003), who show that health care expenditures cannot be explained by ignoring GDP growth. Previous studies, including Newhouse (1977, 1987, 1992, 2001), have shown that much of the spending on health comes from the fact that once a state's GDP increases, welfare is improved by spending more on health care, training, increased wages and improved quality of life. We have included General Expenditures as a percentage of GDP (GENEXP) as another control variable. Our model also integrates savings over GDP (SAVING), so we want to integrate economic variables to analyse their impact in reducing or increasing health care costs. Subsequently, we included other variables to test the robustness of our model. Labour productivity (PROD) is one of our control variables. We included it because we believe, like Hartwig (2008), that good productivity in the care sector improves the quality of work and reduces costs. We include the activity rate of 65-69 year olds (ACTIVERATE 65-69) in order to determine whether this category of active people would have an impact on health care expenditures. We have also included a technology variable (TECHMED) in our regression. This is in line with what Tenand (2014), following Dormont et al. (2009), described as the non-demographic determinants of health care expenditures. Here we have chosen to insert the medical technology of "CT scans", which are measured in terms of the number of scans per million inhabitants. Our model gives this:

$$HEALTH(i,t) = \beta 1DebtCharge(i,t) + \beta 2DEM(Rate\ 65+/15\text{-}64) + \beta 3GdpGrowth(i,t) + \beta 4GenExp(i,t) + \beta 5Saving(i,t) + \mu(i,t). \quad (2)$$

Our sample covers the period 2000 to 2020. Our data are extracted from OECD statistics for most. The pension data for European countries are taken from Eurostat. We work on 33 of the 37 countries that make up the OECD. The following countries: Chile, Colombia, Mexico and Turkey have not been included in our study, as data from these countries are not always available or irregular. Our analysis will be carried out by the ordinary least squares method and our data are in panel. Working on a time arc and on several countries, it is thus obvious that panel analysis is the appropriate method. As our data are not perfect, we will have to conduct basic tests to avoid endogeneity, multicollinearities or even heteroscedasticity. The Hausman test allowed us to choose in both models a fixed effect regression that we regress with standard robustness of errors. The multicollinearity tests allowed us to evacuate in our regressions the highly correlated independent variables. The Breusch-Pagan Heteroscedasticity tests were conducted in our regressions. In addition, to correct for potential endogeneity errors we introduced in the regression the variable lagged by one period the dependent variable in model 4. We also lagged the variables DEBTCHARGE, GDPGROWTH, GENEXP, SAVING by one period. Our models take the following form:

1- $$PENSION(i,t) = \beta 1DebtCharge(t\text{-}1)(i,t) + \beta 2DEM(Rate\ 65+/15\text{-}64)(i,t) + \beta 2GdpGrowth(t\text{-}1)(i,t) + \beta 3GENExp(t\text{-}1)(i,t) + \beta 4Saving(t\text{-}1)(i,t) + \beta 6Taxes(t\text{-}1)(i,t) + \mu(i,t). \quad (3)$$

2- $HEALTH(i,t) = \beta 1Health(t-1)(i,t) + \beta 2DebtCharge(t-1)(i,t) + \beta 3DEM(Rate\ 65+/15-64)(i,t) + \beta 4GdpGrowth\ (t-1)(i,t) + \beta 5GENExp(t-1)(i,t) + \beta 6Saving(t-1)(i,t) + \mu(i,t).$ (4)

The following table describes the variables used in our regressions and the sources where there have been extracted.

**Table 1: Variable description**

| VARIABLE | DESCRIPTION | DATA SOURCES |
|---|---|---|
| Pension | Pension expenditure on GDP. | Eurostat & OECD |
| Health | Health care Expenditure on GDP, not including long-term care. | OECD |
| DebtCharge | Debt burden on GDP. | OECD |
| GDPGrowth | GDP growth aggregate per year. | OECD |
| GenExp | Total government expenditure as a percentage of GDP. | OECD |
| Saving | Aggregate savings as a percentage of GDP. | OECD |
| Taxes | Average income tax (% gross wage earnings). Single person at 100% of average earnings, no child. | OECD |
| ActivityRate 65-69 | Labor force participation rate of people aged 65-69. | OECD |
| LaborProductivity | Labor productivity is defined here as output volume divided by total input labor. | OECD |
| MedicalTech | Tomography scanner used in medical imaging to scan the human body. | OECD |
| DepRate 15-64Y | The old-age dependency ratio is the number of people aged 65 and over per 100 people of working age, i.e. people aged 20-64. | OECD |
| DepRate 0-15Y | The youth dependency ratio is the number of people aged 0-15 per 100 people of working age, i.e. people aged 20-64. | OECD |
| DepRate 0-15 & 65Y+ | The total dependency ratio is the number of people aged 0-15 & 65 and over per 100 people of working age, i.e. people aged 20-64. | OECD |
| Pop 65Y+ | Population aged 65 and over out of total population. | OECD |
| Pop 80Y+ | Population aged 80 and over out of total population. | OECD |

Source: (Author's construct, 2023)

The descriptive statistics of our study are presented in the table below.

**Table 2: descriptive statistic**

| | Obs | mean | Var | St.Dev | min | max |
|---|---|---|---|---|---|---|
| **Pension** | 651 | 9.215295 | 13.65563 | 3.695352 | 1.078 | 17.9 |
| **Health** | 680 | 8.58649 | 4.335326 | 2.082144 | 3.898 | 16.844 |
| **DebtCharge** | 671 | 1.507228 | 2.614434 | 1.616921 | -3.180441 | 7.269771 |
| **GdpGrowth** | 693 | 4.307808 | 24.49808 | 4.949553 | -22.60013 | 34.75724 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| **GenExp** | 693 | 43.67434 | 50.67845 | 7.11888 | 23.68063 | 65.10932 |
| **SavingGDP** | 662 | 6.736831 | 34.49241 | 5.873024 | -12.8465 | 27.50576 |
| **Taxes** | 693 | 16.73069 | 44.01295 | 6.634225 | 2.205467 | 38.5842 |
| **ActivityRate65-69** | 685 | 17.73032 | 156.7537 | 12.52013 | 1.078685 | 55.56751 |
| **LaborProductivity** | 693 | 0.9494023 | 0.0088677 | .0941687 | 60.5195316 | 1.162237 |
| **MedicalTech** | 511 | 22.98472 | 197.1911 | 14.04247 | 4.42 | 111.49 |
| **DepRate 15-64Y** | 692 | 24.43898 | 29.01688 | 5.386732 | 10.07 | 48.71 |
| **DepRate 0-15Y** | 690 | 25.7327 | 24.92823 | 4.992818 | 17.63 | 47.17 |
| **DepRate 0-15 & 65Y+** | 690 | 50.16913 | 28.99044 | 5.384277 | 36.19 | 68.85 |
| **POP 65Y+** | 693 | 16.20058 | 10.41092 | 3.226596 | 7.2 | 28.9 |
| **POP 80Y+** | 693 | 4.116883 | 1.431839 | 1.196595 | 1 | 9.3 |

*Data are from OECD statistic and Eurostat, Table made with Stata.*

**4.3 Interpretation and results**

The results of our various regressions are reported in the tables below:

**Table 3: regression on pension**

| Dependent var: Pension | Reg. 1 | Reg. 2 | Reg. 3 | Reg. 4 | Reg. 5 | Reg. 6 | Reg. 7 |
|---|---|---|---|---|---|---|---|
| LagDebtCharge | -0.051 | -0.105 | -0.146 | -0.050 | -0.061 | -0.045 | -0.156 |
| | (0.096) | (0.099) | (0.114) | (0.095) | (0.106) | (0.110) | (0.102) |
| DEM(Rate 65+/15-64) | 0.124*** | | | | | | |
| | (0.025) | | | | | | |
| LagGdpGrowth | -0.041*** | -0.050*** | -0.046*** | -0.038*** | -0.035*** | -0.053*** | -0.039*** |
| | (0.014) | (0.016) | (0.016) | (0.013) | (0.013) | (0.016) | (0.014) |
| LagGenExp | 0.088*** | 0.096*** | 0.099*** | 0.087*** | 0.088*** | 0.095*** | 0.102*** |
| | (0.017) | (0.020) | (0.026) | (0.017) | (0.020) | (0.022) | (0.019) |
| LagSaving | -0.067** | -0.055** | -0.065** | -0.070*** | -0.062** | -0.056** | -0.076*** |
| | (0.025) | (0.025) | (0.031) | (0.025) | (0.029) | (0.027) | (0.025) |
| LagTaxes | 0.049* | 0.047 | 0.048 | 0.049* | 0.062* | 0.077** | 0.064* |
| | (0.027) | (0.033) | (0.039) | (0.027) | (0.031) | (0.036) | (0.037) |
| DEM (Rate 0-15 & 65+/15-64) | | 0.104*** | | | | | |
| | | (0.025) | | | | | |
| DEM (Rate 0-15 /15-64) | | | -0.069 | | | | |
| | | | (0.058) | | | | |
| DEM (Pop 65 ans+) | | | | 0.224*** | | | |
| | | | | (0.046) | | | |
| DEM (Pop 80 ans+) | | | | | 0.499*** | | |
| | | | | | (0.126) | | |
| ActivityRate 65-69 | | | | | | 0.056*** | |
| | | | | | | (0.017) | |
| LabProductivity | | | | | | | 2.469* |
| | | | | | | | (1.237) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Constant | 2.548* | 0.076 | 7.010*** | 1.990 | 3.242** | 3.867*** | 2.575 |
| | (1.284) | (1.908) | (2.039) | (1.355) | (1.323) | (1.243) | (2.033) |
| Observations | 576 | 576 | 576 | 576 | 576 | 573 | 576 |
| R-Sq | 0.544 | 0.507 | 0.417 | 0.544 | 0.538 | 0.452 | 0.446 |
| N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |

Robust Standard Errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

The regressions reported in Table 3 provide results that we will attempt to analyze and interpret. In the first regression, our key variable, the Lag of debt charges (DEBTCHARGE), did not prove to be significant, but the negative sign tells us that if it were to be significant, it would contribute to lowering pension expenditures. This result is in line with the study of Schneider (2009), who showed that public debt was not significant. Since debt charges are closely related to public debt, we retain this result. This regression answers our question of whether debt charges would crowd out ageing expenditures. Since our key variable does not explain pensions, it would not be a threat to the sustainability of pension expenditures. As we have shown in many OECD countries this ratio is sometimes less than 1% of GDP. Our second variable DEM (Rate 65+/15-64) is unsurprisingly significant and positively (1%) correlated with pension expenditures. A one-percentage point increase in the old-age dependency ratio leads to a 25% increase in pension expenditures. Schneider (2009) has done a similar study and shows that the dependency ratio is positively correlated with pension reforms. This shows why it is important for policy makers to pay close attention to this ratio. Because if it is increasing at a rapid pace and there are not enough workers entering the labour market, especially in pay-as-you-go pension systems, fiscal policy will require either cost-cutting in other sectors, increased taxation, cuts in general expenditures or reforms such as raising the retirement age. Other control variables inserted in the analysis include Lag of GDP Growth (GDPGROWTH), which in our regression proved to be negatively significant. Razin et al. (2002), who analyzed the growth of GDP per capita over social transfers, obtained a similar result. This result seems strange to us, as one would have expected the sign to be positive. This is because the more the economy grows, the more possibility for manoeuvre there is for the government to take care of people in retirement. There is a consistent explanation for this result. In fact, when the economy grows, this is reflected on citizens via wages and transfers. In this case, purchasing power increases, which gives citizens the possibility to subscribe to private or supplementary forms of pension, thus, reducing the governmental burden. In addition, the regression of the LagGenExp variable (GENEXP) obtained a significant and positive result (1%) with pensions; which is not in itself a surprise. Because when the public budget foresees an increase in overall expenditures, this translates into an increase in transfers to citizens, including the elderly. The variable LagSavingGdp (SAVING) was found to be negatively significant at the 5% level. This is explained by the fact that the accumulation of savings reflects an increase in wealth and capital, which means an increase in wealth per capita. Citizens will be inclined to subscribe to other forms of pensions (supplementary and private) thus reducing government expenditures. Turner et al. (1998), Disney (1996) and Weil (2006), have drawn attention to the importance of savings because if savings decline, investment will decline, aggregate and pro-capita GDP growth will fall significantly. Interest rates at that time will rise. The variable LagTaxes (TAXES) is weakly significant at 10% of the confidentiality threshold. The sign is in line with what we expected. In fact, the increase in taxes reflects a restrictive fiscal policy to correct the government's financing needs. In the case of an increase in the old-age dependency ratio or of people going into retirement, the increase in taxes translates into an increase in pension expenditures. As regression 1 was our base model, other variables were included in our work as controls. In regression 2 we have included the variable DEM (total dependence rate (0-15 and 65+/15-64 years)). The sign is positive as in regression 1 with the old age dependency ratio. In regression 3, we included the variable DEM (dependence rate 0-15). This was not significant for public pension purposes although the sign is negative. In regression 4, we have inserted the variable DEM (Population 65+), which like the other variables relating to the elderly is significant at the 1% threshold. In regression 5, we included the variable DEM (population 80+) which, not surprisingly, is positively and significantly correlated at the 1% level. In regression 6, we included the variable activity rate 65-69 (ACTIVERATE 65-69), which reflects the number of people aged between 65 and 69 who are still in employment. The result reveals a positive significance at the 1% level, which would mean that people in activity increasing their income through work contributes to the improvement of fiscal policy via the taxes paid and this contributes to increase public pension expenditures. This is the reason why many countries would like to reform their pension systems by keeping people in the labor market as long as possible, at least those who still have the capacity to stay there. In regression 7, we included the variable labor productivity (PROD). The result gives us a weak significance at the 10% threshold, which reveals that labor productivity is positively associated with pension expenditures. In fact, in a situation of population ageing, the government's option remains to encourage productivity improvement. This is what Hartwig (2008), said about the costs of health care that we can also include in pensions. He showed that productivity improvements lead to wage improvements, which in turn, allow for sufficient tax revenues and a proportional increase in public expenditures, including pensions.

In addition to pensions, we conducted a study on health care in relation to interest charges, the results of which are shown in Table 4.

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**Table 4: Regression on health spending**

| Dependent Var: Health | Reg. 1 | Reg. 2 | Reg. 3 | Reg. 4 | Reg. 5 | Reg. 6 | Reg. 7 |
|---|---|---|---|---|---|---|---|
| LagHealth | 0.768*** | 0.792*** | 0.838*** | 0.766*** | 0.801*** | 0.772*** | 0.752*** |
| | (0.039) | (0.039) | (0.033) | (0.039) | (0.035) | (0.038) | (0.049) |
| LagDebtCharge | -0.116*** | -0.120*** | -0.118*** | -0.116*** | -0.100*** | -0.115*** | -0.093** |
| | (0.033) | (0.036) | (0.034) | (0.033) | (0.034) | (0.032) | (0.040) |
| DEM(Rate 65+/15-64) | 0.026** | | | | | 0.028** | 0.022 |
| | (0.010) | | | | | (0.011) | (0.013) |
| LagGdpGrowth | 0.017*** | 0.016*** | 0.018*** | 0.018*** | 0.017*** | 0.017*** | 0.013** |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| GenExp | 0.076*** | 0.076*** | 0.074*** | 0.076*** | 0.075*** | 0.075*** | 0.065*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.006) |
| LagSaving | 0.027** | 0.031*** | 0.033*** | 0.026** | 0.030*** | 0.028** | 0.028** |
| | (0.010) | (0.010) | (0.011) | (0.010) | (0.010) | (0.010) | (0.012) |
| DEM (Rate0-15and 65+/15-64) | | 0.021** | | | | | |
| | | (0.009) | | | | | |
| DEM (Rate 0-15 / 15-64) | | | 0.001 | | | | |
| | | | (0.015) | | | | |
| DEM (POP 65 +) | | | | 0.049*** | | | |
| | | | | (0.018) | | | |
| ActivityRate 65-69 | | | | | 0.012 | | |
| | | | | | (0.007) | | |
| LaborProd | | | | | | -0.111 | |
| | | | | | | (0.256) | |
| TechMed | | | | | | | -0.000 |
| | | | | | | | (0.006) |
| Costante | -1.939*** | -2.592*** | -1.877** | -2.059*** | -1.779*** | -1.876*** | -1.238** |
| | (0.466) | (0.608) | (0.804) | (0.478) | (0.482) | (0.506) | (0.494) |
| Observations | 601 | 601 | 601 | 601 | 597 | 601 | 448 |
| R-sq | 0.888 | 0.887 | 0.883 | 0.888 | 0.884 | 0.888 | 0.869 |
| NumberCountry | 32 | 32 | 32 | 32 | 32 | 32 | 30 |

Robust Standard Errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

The regressions conducted in the analysis of health care yielded equally important results as the regressions conducted on pensions. The results of our basic model are listed in regression 1. Not surprisingly, the lagged dependent variable LagHealth (HEALTH) is positively and significantly correlated with the dependent variable. In fact, last year's expenditures on health care determines the current year's spending. Our key variable LagDebtCharge (DEBTCHARGE) in relation to health expenditures is significant at the 1% level of confidentiality. The signs are identical to the analysis on pensions. This reflects that health care costs would be crowded out if debt service costs were increasing. This is a strong signal in a context where OECD countries are experiencing an increase in the number of elderly people, which will be further accentuated in the coming decades. It is therefore important, as we recommend to the authorities, to take advantage of low market interest rates to work on accumulating primary surpluses that can reduce the public debt to GDP ratio and ipso facto the debt burden. Our second variable DEM (Rate 65+/15-64) is also significantly positive at the 5% level as is the regression on pension costs. It is true that the work of Dormont (Dormont (2010 and 2012), Dormont and Huber (2009), Dormont et al. (2006)), has long shown that health care costs are weakly explained by the ageing of the population, but we find in our sample a significance of 5%. This shows that the increase in the number of elderly people will certainly lead to additional costs, especially in long-term care. The variable LagGdpGrowth (GDPGROWTH) is significantly positive, which is quite the opposite of the result found for pensions. We retain this result because we believe that health care is primarily a question of government spending. Moreover, in this context, an increase in GDP leads to an improvement in salaries and, as a result, fiscal policy improves, giving the authorities the possibility for manoeuvre to increase spending on health care. In any case, improving living conditions through better health care is a plus for productivity. This is the conclusion reached by Jochen Hartwig (2008). The GenExp variable (GENEXP) is significant and positive at the 1% level. This result is consistent with our analysis. In fact, an increase in the public budget devoted to general expenditures leads to an increase in health care expenditures. The variable LagSaving (SAVING), is significant at the 5% level and positively correlated, which is contrary to the result obtained in the pension regression. We maintain this result because we believe that savings, even if counted at the aggregate level, are primarily individual savings. And, once the individual increases his savings, he is more inclined to invest in his personal health and also willing to increase the

taxes that will ultimately be used for public spending on health care. In regression 2, we included the variable DEM (Rate 0-15 and 65+/15-64) to capture the effects of the young and the elderly population on health expenditures. We find that this is significant at the 5% level, showing that the accumulation of these two variables is a heavy burden on the health system and if there is not enough labor available or good productivity, the budget deficit could increase further. Taken separately, regression 3 where we highlight the youth dependency ratio DEM (DepRatio 0-15), did not show any significance. Subsequently, regression 4 allowed us to single out the population aged 65+ (DEM (Pop 65+)). Unsurprisingly, as studies on health care demands show (Bogaert and Bains (2003), the older ages are the ones where care is needed to cope with age-related diseases (diabetes, Alzheimer's, etc.), so the care burden is likely to increase if this category of people is growing. Hence better policies to encourage people who are still able to work to remain in the labor market, which would increase workers taxation and allow better financing of such cares. This is why in regression 5 we wanted to capture the effect of people in employment between 65 and 69 years (ACTIVERATE 65-69) on health care. This did not show any significant effects. In regressions 6 and 7, we have highlighted labor productivity (PROD) and medical technology (TechMed). The results of these regressions are not significant. The case of medical technology is particularly interesting. For Westerhout (2006), we know that technological development implies an increase in health-related expenditures, while Dormont (2009), mitigates this by insisting on the type of technological innovation (diffusion effect and substitution effect). The former increases costs and the latter reduces them. This is to show that the impact of technology is quite ambiguous. Nevertheless, in our analysis it has a negative sign. If it were significant, this would imply that CT scanners contribute to lowering health care costs, especially in medical scanners.

**4.4 A cross sectional analysis**

Given the fact that our regressions showed some ambiguity in the above regression results. The regression of pensions on debt charges showed insignificance, while the regression of health care proved to be significant. In this section, we have run cross-sectional regressions to interpret and analyze the results. This was done in order to also take into account the time factor, which is represented here by years. Our models here are quite simple. We regress our main variables (PENSION and HEALTH) on the public debt charges (DEBTCHARGE). Our equations have the following forms:

$$PENSION\ (i,t) = \beta 1 DebtCharge(i,t) + \mu(i,t) \qquad (5)$$

$$HEALTH\ (i,t) = \beta 1 DebtCharge(i,t) + \mu(i,t) \qquad (6)$$

The results are presented in Tables 5 and 6. These results are fairly standard in both regressions. In table 5, the observed signs are opposite to the results of the panel regressions. This would imply that the more the debt burden increases automatically the more the pension expenditures increase. This could also be an avenue for further analysis. Indeed, one could imagine that when the state gets into debt and therefore increases the debt charges, it is to face the pension expenses due to the implicit debt or because the national income could not cover it. It is then possible to have such a result, which is verified over the 20 years of our analysis. The same is observed in the regressions in Table 6 relating to health care expenditures to debt charges. The positive significances are indicative of an ambiguity. For in the panel analysis, the regression of these variables was found to be negatively significant. This is also an issue to be taken into account in subsequent analyses. Keynesian theories supporting an expansive fiscal policy can explain such a result. Indeed, in order to revive the economy, investment made for the purposes of growth and productivity generating positive externalities, allow states to go into debt to finance health care. For an improvement in collective well-being, through better health care for the elderly, for example, would allow them to remain active longer. In this context, the tax base would be broadened, thus allowing for a benefit in society thanks to multiplier effects. Our regression is therefore still ambiguous and needs to be analyzed further.

**Table 5: Pension and debt charges regression**

| Years | Dependent VAR. | DebtCharge | | Obs. | R-squared |
|---|---|---|---|---|---|
| 2000 | PENSION | 2.495*** | (0.331) | 31 | 0.654 |
| 2001 | PENSION | 2.581*** | (0.363) | 31 | 0.627 |
| 2002 | PENSION | 2.476*** | (0.401) | 31 | 0.560 |
| 2003 | PENSION | 3.090*** | (0.448) | 31 | 0.614 |
| 2004 | PENSION | 3.119*** | (0.465) | 31 | 0.600 |
| 2005 | PENSION | 3.207*** | (0.493) | 31 | 0.585 |
| 2006 | PENSION | 3.323*** | (0.525) | 31 | 0.572 |
| 2007 | PENSION | 3.099*** | (0.547) | 31 | 0.517 |
| 2008 | PENSION | 3.011*** | (0.577) | 32 | 0.468 |
| 2009 | PENSION | 3.342*** | (0.593) | 32 | 0.506 |
| 2010 | PENSION | 3.544*** | (0.537) | 32 | 0.584 |
| 2011 | PENSION | 3.289*** | (0.474) | 32 | 0.608 |

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|---|---|---|---|---|---|
| 2012 | PENSION | 3.506*** | (0.488) | 32 | 0.625 |
| 2013 | PENSION | 3.652*** | (0.536) | 32 | 0.599 |
| 2014 | PENSION | 3.676*** | (0.562) | 32 | 0.580 |
| 2015 | PENSION | 3.831*** | (0.621) | 32 | 0.551 |
| 2016 | PENSION | 4.061*** | (0.683) | 31 | 0.541 |
| 2017 | PENSION | 3.995*** | (0.709) | 32 | 0.506 |
| 2018 | PENSION | 5.010*** | (0.743) | 28 | 0.627 |
| 2019 | PENSION | 5.900*** | (0.980) | 23 | 0.623 |
| 2020 | PENSION | 6.798*** | -1.549 | 12 | 0.637 |

Robust Standard Errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

**Table 6: Health care spending and debt charges regression**

| Years | Dependent VAR | DebtCharges | | Obs. | R-squared |
|---|---|---|---|---|---|
| 2000 | Health | 2.037*** | (0.296) | 32 | 0.605 |
| 2001 | Health | 2.139*** | (0.335) | 32 | 0.568 |
| 2002 | Health | 2.134*** | (0.367) | 32 | 0.521 |
| 2003 | Health | 2.708*** | (0.423) | 32 | 0.569 |
| 2004 | Health | 2.744*** | (0.449) | 32 | 0.546 |
| 2005 | Health | 2.799*** | (0.481) | 32 | 0.522 |
| 2006 | Health | 2.809*** | (0.532) | 32 | 0.473 |
| 2007 | Health | 2.549*** | (0.558) | 32 | 0.403 |
| 2008 | Health | 2.456*** | (0.578) | 32 | 0.368 |
| 2009 | Health | 2.934*** | (0.559) | 32 | 0.471 |
| 2010 | Health | 3.061*** | (0.517) | 32 | 0.530 |
| 2011 | Health | 2.716*** | (0.476) | 32 | 0.512 |
| 2012 | Health | 2.943*** | (0.471) | 32 | 0.557 |
| 2013 | Health | 2.981*** | (0.512) | 32 | 0.522 |
| 2014 | Health | 2.987*** | (0.534) | 32 | 0.502 |
| 2015 | Health | 3.129*** | (0.592) | 32 | 0.474 |
| 2016 | Health | 3.354*** | (0.660) | 31 | 0.463 |
| 2017 | Health | 3.318*** | (0.684) | 32 | 0.431 |
| 2018 | Health | 3.632*** | (0.749) | 32 | 0.431 |
| 2019 | Health | 3.895*** | (0.840) | 32 | 0.409 |
| 2020 | Health | 3.663** | (-1281) | 20 | 0.301 |

Robust Standard Errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

**5. Conclusion and recommendations.**

Spending on pensions and health care are undoubtedly very important pockets of public expenditures for the social well-being of OECD countries. Studies in this area show a considerable increase in the coming decades if nothing is done, due to the ageing of the population. The objective of this paper was to evaluate whether the interest charges could be a threat for the "said" ageing expenditures. In our study, we have highlighted debt burden in an attempt to answer the question of whether these can be crowding out pension and health care spendings. The empirical results showed that debt charges are ambiguous in the current context. Indeed, the ordinary least squares analysis did not show a certain homogeneity in the tests performed. The tests on pension expenditures were not significant with the panel data. The negative sign nevertheless showed that if they were to be significant, these charges would crowd out pension expenditures. Tests on health care costs have shown some significance in panel data. And logically, this would mean that in the event of an increase in public debt charges, health care spending would be threatened. However, as the two regressions did not give a certain homogeneity in the results, we proceeded to cross-sectional regressions to take into account the time factor and analyse the results. We have noted that the results are homogeneous in both settings. But the signs obtained were contrary to the regressions carried out in the panel. Hence the ambiguity in our results. we can say, however, that given the current low interest rates on the market reflecting in the debt charges, we can say that these would not currently threaten the "said" ageing expenditures. On the other hand, demographic variables such as the ratio of elderly people, the population over 65 and 80 years old showed a strong correlation in both pension expenditures and health care. This shows that the latter are likely to put additional pressure on pensions and health care. Hence the call for reforms to encourage people to stay in work for a long time in sectors where this is possible. Also, the integration into the labor market of immigrants for whom this is often difficult to access could also be a solution. Also, reforms, especially in pension systems, should be made in the sense of rationing expenditures, taking into consideration future generations; this is a country by country analysis. In health care, improved medical technology should go hand in hand with improved care and cost cutting. This is mainly a question of reviewing patent policies. In the end, we believe that the burden on the public debt as said above, should not be a threat to the sustainability of ageing expenditures. At most, the increasing old-age and senior dependency ratio should be the main concern of policy makers. In the context of ageing, policies would take advantage of low

debt burdens to direct spending in policies that would improve the sustainability of ageing expenditures. Policies to improve human capital could be an example. Spendings on education and training are strongly recommended, especially in sectors with high capital returns, such as technology and innovation sectors, research and development and so on. A well-trained human capital could improve overall productivity, which in turn would generate economic growth, thus making it possible to meet the costs of pensions and health care. Shouldn't we think about investing in human capital through education and training to boost wealth-generating productivity?

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