

Human Capital Productivity and "ageing" Expenditure: An OECD Study

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Abstract

Demographic ageing that is already evident in many OECD countries will become more acute in the coming decades. The costs associated with this phenomenon are most apparent in spending on pensions, healthcare and long-term care. Among the solutions put forward to deal with this, the productivity of human capital is the one we propose and analyze. According to Mincer's theory, the salary, which represents the reward for production, is the variable that we propose to use in the analysis of human capital productivity. Salary is the materialization of work done, so the higher it is, the more productive it is. Salary variation is therefore our dependent variable and spending on pensions and healthcare are our key independent variables. Our analysis covers 33 of the 37 countries that make up the OECD system. We use the ordinary least squares method on panel data covering the period 2000-2020. Our key independent variables show a negative correlation with salary variation. This would mean that an increase in spending on pensions and healthcare would lead to a reduction in salaries to cover these costs. However, as our education variables (average years of study, employment rate of secondary and tertiary graduates...) show a positive correlation with salary variation, we can undoubtedly state that improving human capital through education and training is the solution to be encouraged by the public authorities in a context of ageing.

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1. Introduction

Demographic ageing is already a reality today and will be one of the real challenges for many OECD countries in the coming decades. The alarm bells are already ringing these days among experts in the field, whether in academia or politics. Studies in this area call for in-depth reflection on the potential solutions that could be envisaged to deal with the problem, because the issues of such a phenomenon are primarily economic and budgetary. It is important to remember, however, that demographic ageing is the result of a low fertility rate and an increase in life expectancy, due to improved healthcare and healthier lifestyles. The challenges of demographic ageing are therefore linked to spending on pensions, healthcare and long-term care, and to some extent education and training. Given the scale of these expenditures, public finances will have to invent new ways of maintaining long-term sustainability. To deal with this unprecedented situation, a number of approaches have been adopted in the scientific world. Lee and Mason (2016), for instance, point out that it is possible to take action on taxation. Indeed, in a context where the dependency ratio is tending to increase, the easiest thing to do would be to work on taxation, either by increasing taxes on workers or companies, i.e. by increasing revenue in general, or by reducing the benefits granted to those entitled to them. The problem, as several experts have pointed out, is that taxation in many OECD countries is generally high. And any further increase would be a brake on economic activity. A reduction in spending will also have an impact on the purchasing power of those affected by these policies. In addition, raising the retirement age is often put forward as a way of meeting the costs of ageing, as proposed by many authors, including Oksanen (2009). Pushing back the retirement age increases the number of years of contributions, whether in a pay-as-you-go or funded system. This will increase the number of taxpayers and ipso facto the tax base. The criticism of this approach lies in the discussions surrounding it. Deciding on the right age to make this policy profitable depends on a number of factors, including health, professional and social factors. Indeed, even if public policies define a theoretical retirement age, the fact remains that the actual retirement age is generally much lower than that officially defined. In addition, immigration which is often proposed as an alternative solution, harbours a number of social and political concerns. For instance, Xavier Chojnicki et al. (2005), in their paper "l'immigration "choisie" face aux défis économiques du vieillissement démographique", show, describe and present two types of immigration: the replacement one that makes it possible to bridge the gaps in the size of the working-age population; and that known as "chosen", which is an immigration in which the native-born and immigrants have the same level of skills. Notwithstanding these studies suggesting numerous advantages to integrating immigrants, the fact remains that this policy is very often contested and difficult to apply. In the light of all that has been discussed, we propose a different approach that would make it possible to maintain the sustainability of ageing-related expenditure: the productivity of human capital, that will be the subject of this paper. Canals et al. (2015), define human capital as all the

productive capacities that an individual acquires through the accumulation of general or specific knowledge and know-how. General knowledge reflects knowledge acquired through teaching and education. Specific knowledge reflects knowledge acquired in the professional environment. Boccanfuso et al. (2009), propose a definition taken from Becker (1974), stating that human capital can be seen as all the productive talents and skills of the worker, whether acquired informally (through experience) or formally (through education or training). It can also be defined as all the investments such as education, health and on-the-job learning that improve a person's productivity in the labor market and in other areas. Following the definitions proposed above, we believe that human capital productivity could be an exploitable avenue for the analysis of the sustainability of "so-called" aging expenditures. Improving human capital raises overall productivity, which in turn improves workers' incomes, which in turn increases public revenue. Our problem is therefore to find out whether improving human capital could be an alternative in the stability of "ageing" expenditure. Productivity of human capital is analyzed using Mincer's (1984) approach, which concludes that individuals are paid at their marginal productivity, which reflects their human capital. In his view, if the proportional increase in earnings caused by years of schooling is constant throughout life, then the logarithm of earnings would be linearly related to these years of schooling. Salary remuneration would be the sign of a constant improvement in human capital, resulting in a higher salary. Schultz (1961), in his approach, highlights human capital as a stimulator of productivity through creativity and adaptability, among other things. Human capital is essential for improving physical capital and, given that people are constantly being trained, even in old age, it is possible to continue to be productive. We will therefore focus in this work on salary compensation as the dependent variable, and our key variables will be spending on pensions and healthcare, defined here as a percentage of GDP. As our dependent variable is analyzed at macroeconomic level, we will use the annual variation in salaries. Other control variables will also be included in the analysis. These include the GDP growth rate, the employment rate of secondary and tertiary graduates, the average number of years of education, the savings rate, the inflation rate, the demographic dependency ratio, the trade balance and the governance control variables (control of corruption, political stability and the rule of law). Our data covers the period 2000 to 2020 and are extracted from OECD statistics and the World Bank database. We use the ordinary least squares method with fixed effects. The results of our regression show a negative correlation between salary variation and spending on pensions and healthcare. Significance at the 1% level shows a strong correlation between these expenses and salary increases. In our view, this is logical, as increased spending on pensions, for example, can lead to a reduction in salaries for this social category. Because in a context where the number of elderly people is constantly increasing, the financing of social expenditure has to come from the working population. Net salaries are likely to be reduced because the high levies on these assets would lead to a reduction in personal earnings to meet these charges. However, given the positive significance of the educational variables, in particular

the average number of years of study with the salary variable, we can say that if a large number of people in the economy are educated, and given that wage remuneration is the sign of a certain productivity, the assumption of "so-called" ageing expenses would find a solution in the long term. The rest of our work will be organized as follows: following this introduction, a second part will analyze human capital, starting with definitions and summarizing the main approaches that have analyzed the productivity of human capital. In the third section, we will analyze the relationship between human capital and demographic ageing. In the fourth section, we will review the literature. In the fifth part, we will carry out an empirical analysis and the sixth part will conclude our work.

2. Conceptual and theoretical analysis of human capital

2.1 Conceptual analysis

Human capital has been the subject of a vast literature. It is therefore essential to start with a conceptual definition. The OECD defines human capital, taken from Keeley (2007), as the set of knowledge, skills, competencies and attributes embodied by individuals that facilitate the creation of personal, social and economic well-being. This generic and vague definition is supplemented by Canals et al. (2015), who see human capital as all the productive capacities that an individual acquires through the accumulation of general or specific knowledge and know-how. General knowledge reflects knowledge acquired through teaching and education. Specific knowledge reflects knowledge acquired in general in the professional environment. Becker (1974), was more explicit, and was echoed by Bocanfuso et al. (2009), when he said that human capital can be understood as all the productive talents and skills of the worker, whether acquired informally (through experience) or formally (through education or training). It can also be defined as the set of investments, such as education, health and on-the-job learning, that improve a person's productivity in the labor market and in other areas. The element highlighted in this last definition is health. This is in line with Schultz (1961), who presents education as the process (flow) by which people acquire skills and knowledge. Since the stock of educated people with skills and knowledge is equated with trained people, it is referred to as human capital. According to this definition, education measured by enrolment rates contributes to the accumulation of human capital stock, which is measured by the level of education of the adult population.

2.2 An Analysis of human capital theories

Since Adam Smith (1776), in *The Wealth of Nations*, taken up by Bocanfuso et al. (2009), the author has argued that investment in human capital makes it possible to increase future productivity. In so doing, he highlighted the importance of education and training in determining individual productivity and income. After Smith, human capital was the subject of several other theories. In Canals et al (2015), Schultz's theory is revisited. Schultz (1961) sees investment in human capital as all the direct expenditure on education, health and migration that gives access to better jobs,

which are the most relevant to the creation of wealth or the improvement of GDP. Schultz identifies five main types of activity that play an essential role in improving human capabilities. These include health facilities and services, formal education (primary, secondary and tertiary), training including apprenticeships within companies, adult training programs not organized by companies, and migration of individuals. These activities are all important in improving the process of human capital formation. For instance, improving the health system enables people to work in good physical condition, which will improve individual productivity. Migration allows people who are unable to train locally to acquire knowledge in other parts of the world. The case of the Asian tigers and many African countries are some examples, whose skills acquired abroad have given or are giving emigrants from these countries access to knowledge that is not available in their own countries, which in the process of technology transfer has enabled or will enable these countries to catch up with other advanced countries. In order to analyze the effects of education growth on wages, it is necessary, according to Schultz (1961), to distinguish the stock of education held by the population from the quantity of the labor force. It chooses to measure the knowledge acquired by individuals during the school year. He evaluates human capital by the real costs of education to the economy, i.e. opportunity and teaching costs. This is fundamental insofar as it is a nation's ability to capitalize on this stock of human capital that will make the difference. For example, Schultz (1961), quoted by Breton (2013), showed that a nation's ability to use physical capital productively is a function of its level of human capital. And if its human capital does not grow at the same pace as its physical capital, then human capital becomes the factor limiting its economic growth. He takes as an example the rich countries, which he observes were devastated by the Second World War and quickly made use of massive amounts of investment in physical capital, certainly thanks to the human capital that accompanied this revolution.

Becker also theorized about human capital. He defines it as all the productive talents and skills of the worker, whether acquired informally (through experience) or formally (through education or training). It can also be defined as the set of investments, such as education, health and on-the-job learning, that improve a person's productivity on the labor market, and in other areas Boccanfuso et al. (2009). Here he focuses on activities likely to influence the well-being of workers and therefore have an impact on wages and consumption. His ultimate aim is to study factors other than education, such as the health of workers, which enable them to be more productive.

Mincer's theory is moreover analyzed in relation to human capital in Boccanfuso et al. (2009). Mincer starts from the orthodox theory of human capital, which concludes that individuals are remunerated at their marginal productivity, which reflects their level of human capital. The quantity and quality of training received thus appears to be an essential determinant of earnings for each individual. The focus is on formal and informal training over the course of a professional career. Because people who are willing to train increase their real income, each one have

to increase his/her training to have better earnings throughout entire life. If Mincer (1974), quoted by Krueger and Lindhal (2001), showed that if the only cost of an additional year of schooling is the opportunity cost of students' time, and if the proportional increase in earnings caused by this additional schooling is constant throughout life, then the logarithm of earnings would be linearly related to individuals' years of schooling. And the slope of this relationship could be interpreted as the rate of return on the investment in schooling. This would mean, in other words, that if the population is continuously trained, the increase in earnings would not be a reward for years of study, as Krueger and Lindhal (2001) questioned, but an added value in improving the productivity of OECD countries. And, in a context of demographic ageing, if workers are better qualified, long-term job stability will guarantee them a longer period in the labor market. This partly solves the problem of early retirement, improves the tax base and improves public finances.

3. Human capital productivity and demographic ageing

Many solutions have been proposed to deal with the burdens of ageing. In this work, we propose the productivity of human capital through education and training. Our starting point here is education and human capital, the subject of work by Fougère et al. (2009), Fougère and Merette (2000a) and Fougère and Merette (2000b). Their starting point is the observation that in a rational society, if nothing is done to anticipate the demographic shock, the reduction in the labor force due to population ageing will tend to reduce overall savings. Its impact on productive capacity will have an effect on economic growth and, as a result, funding adult programs would be difficult to sustain. They therefore propose working on human capital, particularly education. It is vital to work on maintaining the sustainability of spending on ageing, since if the funding of adult programs is not guaranteed, the viability of public finances will be threatened. In addition to this pressure from "so-called" ageing-related expenditure, other pressures on public finances, coupled with the low GDP growth projected by researchers, mean that we need to look at long-term solutions. Knowing that the return on human capital is the discounted sum of future wage income, future young cohorts should be inclined to invest more in education and training. As a result, human capital, which plays a direct role in production as a productive factor, and the accumulation of physical capital will directly generate growth in production. Improving human capital also contributes to technical progress by increasing innovation and the dissemination and adoption of new technologies. Through this indirect channel, human capital will influence other growth factors, contributing to an increase in overall productivity. The argument that productivity, which is the capacity to produce more thanks to physical and human capital, is more oriented towards human capital because it is human beings who are endowed with cognitive capacities. To dwell on this work is to show that the reduction in the active workforce due to population ageing would not necessarily have a negative effect in fiscal terms if the active resources are better qualified. In this respect, Siliverstovs et al. (2011), teach us that it is not certain that

economic growth will be particularly negatively affected even if the effective labor supply falls, as this depends above all on the evolution of the supply of capital and productivity. The accumulation of human capital, as measured by education and training, gives us a clearer picture. In this respect, Lutz et al. (2008), teach us that education is the process (flow) by which people acquire skills and knowledge. Thus, the stock of educated people with such skills and knowledge is identified as human capital. This would mean that education, measured by enrolment rates, contributes to the accumulation of human capital stock, which is measured by the level of education of the adult population. An adult population with a large number of educated people will capitalize on human capital to meet the challenges of its economic production. If the accumulation of human capital leads to a reduction in the birth rate and an increase in life expectancy, it is also the solution to the challenges of demographic ageing. El Mahjoubi Khadija (2015), adds to this by showing that it is the level of human capital measured by the average number of years of education of the working population that has a positive and significant effect on the growth rate. This involves capitalizing on all the resources available to the economy, particularly those people who are often considered less important for their role in the accumulation of GDP. These include women, the elderly and migrants. This is one of the descriptions given by Lutz et al. (2008), who show that better-educated women, for example, tend to have significantly lower fertility, lower maternal and infant mortality and greater longevity. A change in the composition of the population of young women in terms of education will therefore have a direct impact on the total number of births. The capitalization of educated people will stimulate growth through work well done, and the reward will be in wages. Given the increase in salaries, the state will be able to take fiscal action to finance ageing. Since the Second World War, school enrolment in industrialized countries has risen steadily. This has had the effect of keeping young people in education for longer. This in turn helps to improve overall productivity. In this paper, we choose to work on the annual salary variation aggregated to the economy.

4. Literature review

While a number of authors in the literature are unanimous about the role played by human capital, investment in it is far from a smooth ride. Indeed, in a context of demographic ageing, tensions can arise between social categories. As spending on pensions and healthcare is often assigned to the older generations, while education and training are the responsibility of young people, the distribution of social spending could be problematic. This is what Baum and Seitz (2003), were already pointing out when they asserted that increased spending on social protection competes with spending on education. This is because when public finances are already stretched, a sharp increase in public spending in one area of social protection (unemployment or disability insurance payments, pensions, etc.) automatically reduces the funds available for other areas of spending. Gradstein & Kaganovich (2004), take the same line, arguing that in a democratic context, as is generally the

case in OECD countries, the growing numbers of older people would put more pressure on social management via their numbers in order to attract more expenditure to it. This is the same observation made by Grob & Wolter (2007), when they inform us that a voter in a democratic decision-making process is likely to put forward his or her own interests. It would therefore seem logical to think that a continuous increase in the age of the median voter would tend to have a negative impact on the funding of other sectors of economic life, particularly education.

In reality, the thesis of a tension between investment in human capital and spending on ageing is only apparent in theory. In fact, several researchers have shown that the elderly, despite their ever-increasing numbers in society, would not be opposed to any funding of training programs for future generations. Although the work of Poterba (1996, 1997 and 1998) highlights a complex relationship between generations, the fact remains that the ageing generations are not opposed to funding programs for young people, including education. Gradstein & Kaganovich (2004), remind us that there are 3 types of motives that would facilitate such an assessment. Older people would not be opposed to spending on education, either because of altruistic concerns for young people, or because of considerations of capitalization of property value Brunner & Balsdon (2004), or because such spending can be seen as a means of improving productivity, thus ensuring a higher return on savings for retirement. Altruism here refers to the fact that older people would feel more or less bound by a generational contract, and would therefore allow the younger generation to benefit from the same funding that they enjoyed during their own youth Grob and Wolter (2007). In any case, in a context of demographic ageing, spending per child and the labor force would fall, due to the ever decreasing number of children per woman, as is the case in many OECD countries. It is therefore in the interests of the elderly to ensure that the younger generation is well educated and more productive, which is essential for the funding of transfer benefits (old-age pensions, healthcare, etc.), the biggest beneficiaries of which are the elderly themselves. The most important aspect is undoubtedly the existence of a positive externality. Poterba (1998), quoted by Harris et al. (2001), points out that older people, by supporting investment in education and training, are in fact hoping to improve the skills and productivity of younger workers so that their wages can be increased. Higher salaries will then lead to higher taxation, which will contribute to the financing of social security via the pensions and the healthcare system. The existence of a positive externality would thus enable the economy to benefit from the growth of human capital.

Improving productivity in an ageing context is undoubtedly the best option to consider. This is why Scarth (2002), in his book, reminded us that in an ageing context, focusing on physical capital to boost productivity was the least feasible option. Since investment in physical capital showed its limits over time. On the other hand, investment in human capital through education and training was the most advisable option. Accumulating human capital improves the productive capacity of individuals. And since the slowdown in fertility and the increase in life expectancy mean that there are more people to take care of in the economy, it is

essential to focus on education and training. Poterba (1998), takes this idea a step further, showing that human capital makes it possible to have a population that is both better educated and capable of innovation, and therefore willing to contribute to improving taxation. This would make it possible to care for the dependent population. The improvement in human and physical capital, the capacity for innovation, the dynamism of the most highly educated generations (both new and old) are all benefits for which productivity is both a cause and a consequence.

When Fougère et al. (2009), addresses the issue of productivity, they start from the observation that the decline in labor supply induced by aging can reduce the rate of return and the incentive to save, while an increase in human capital could help to correct this trend, thus offsetting the effect of ageing on the labor force. This is true insofar as, if retiring generations are not replaced by new ones (replacement rate), the imbalance in social security contributions will be felt in the medium to long term. This is why Catalano & Pezzolla (2016), insist on improving human capital. Indeed, by improving human capital, it increases the quality of work and decreases capital per unit of actual work. In this way, the impact of population ageing on factor prices can be offset. Choi and Shin (2015), make more or less the same observation. For them, the reduction in the supply of labor due to population ageing increases the wage rate, which favors the accumulation of human and physical capital. The increase in human and physical capital largely offsets the negative impact of population aging on economic growth. Fougère et al. (2009), analyzing the importance of human capital, tell us that it is directly involved in production as a productive factor, and that the accumulation of this capital directly generates growth in production. This is what they call the level effect. Human capital can also contribute to technical progress by increasing innovation and the dissemination and adoption of new technologies. Through this indirect channel, it influences growth by increasing productivity. Lindh (2004), confirms that human capital is one of the key factors in productivity growth. In fact, because of the dynamics of improvements in the education system across cohorts, younger cohorts tend to be better educated than older ones. This growth means that we can expect further improvements in the average education level of the workforce. Because the stock of knowledge and skills that emerges will serve as a catalyst for economic recovery. Pelletan & Villemeur (2012), make the same observation. In their view, the younger cohorts have generally been better trained than the older cohorts, which would result in significant productivity in these cohorts. They go further, showing that high levels of human capital tend to be associated with high-productivity jobs, particularly in sectors of technological innovation.

Improving human capital also generates what Mincer (1974), and Krueger & Lindahl (2001), call the opportunity cost. They start from the observation that if human capital is formed through education and training, in other words in both formal and informal settings, the acquisition of these capabilities is made costly and thus becomes an act of investment. Investment in this context is aimed at a medium or long-term return. First of all, this leads to a demand for better-educated workers. The salary offered to this category of workers tends to improve and they are offered

the best jobs. Workers' returns increase the demand for education and training until the wage equilibrium is restored to an equilibrium level. Schwerdt & Turunen (2007), go on to state that the return from investing in education leads to an increase in individual earnings, suggesting that the social return to schooling is also positive, again referred to as the social externalities of education and training. This is why Fougère and Merette (1999), go on to point out that since the return on human capital is the discounted sum of future wage income, it is optimal to invest in post-secondary education when young. This is because an extra year spent studying leads to additional earnings that stabilize throughout life Odden & Clune (1995). Mincer (1974), confirms this by pointing out that the annual wages received by a worker with 's' years of schooling are a linear function of the years of schooling. One more year of schooling will thus increase the worker's wage by 'r' per cent. Increased investment in human capital, increasing the effective supply of skilled labor, will in turn stimulate economic growth. From a fiscal point of view, the increase in salaries, leading to an increase in public revenue, would contribute to the cost of caring for the elderly.

The increase in the number of young, well-educated cohorts leads to an improvement in the demographic dividend. Pelletan & Villemeur (2012), inform us first and foremost that the youngest cohorts have generally been better trained than the older cohorts. Fougère et al. (2009), add to this assertion, telling us that younger, well-trained cohorts (particularly women) lead to an increase in the quality of the workforce, productivity and the number of hours worked. As Mincer (1974) pointed out, an increase in the human capital of young women initially leads to a reduction in the birth rate. Because when staying in education longer, women tend to apply for career jobs, thus reducing their desire to procreate. Secondly, the reduction in the birth rate is reflected in an increase in the well-being of the new generations. This is because better-educated women, despite having a much lower fertility rate, have lower maternal and infant mortality rates and live longer. In terms of health, for example, it has been shown that educated people tend to provide better care at home by respecting food intake, hygiene measures and medical instructions, and to encourage better education among their children, which will ultimately play a very important role in improving human capital Lee & Mason (2016), Lutz et al. (2008). Fougère et al. (2009), tell us that the more the current and future cohorts of middle-aged workers are better qualified and work harder, the more they help to increase production capacity and considerably reduce the economic cost of an ageing population. The accumulation of human capital is therefore a powerful smoothing mechanism.

One of the effects of an improvement in human capital is undoubtedly an increase in per capita and overall income via externalities. Although much debated, human capital is said to increase the economy's overall income. In fact, Marois et al. (2020), speaking of wages and labor productivity, show that the relationship between these elements, although a source of controversy in certain contexts, holds true in the most economically developed countries. In other words, this would mean that the degree of education determines wages, and this can be verified, particularly in advanced

countries. This is also the conclusion reached by Han & Lee (2020), citing Mincer's work. So, if the stock of human capital is remunerated according to the level of education achieved and the training received in the professional world, there is no doubt that income also increases in proportion to the size of the educated population. Referring to Korea, the authors Han & Lee (2020), showed that in the 1970s, 37% of workers aged over 15 had reached secondary level. In 2010, no less than 87% of these workers had completed secondary education. The same is true for university-level workers, the authors continue. This figure rose from 6% to 42% between 1970 and 2010. The transformation of the Korean economic system has thus been achieved over time by replacing less educated and less productive workers with more educated and more productive workers. Korea's GDP growth is effective proof that improving human capital has contributed to its growth, and this can be verified in many economies, particularly those of the Asian tigers. Since economic growth is reflected in global wealth, we could conclude that human capital has an impact on improving the global economy.

Admittedly, the increase in income in the future is the consequence of the opportunity cost of investing in human capital, but many authors suggest that young people should invest in post-secondary education, which is likely to generate higher productivity. Merette and Fougère (1999), for example, argue that since the return on human capital is the discounted sum of future wage income, it is optimal to invest in post-secondary education when young. This is because, since physical capital is replaceable, human capital will be more important in adulthood. This is also confirmed by Fraumeni (2012), who points out that individuals who attain a higher level of education will have higher human capital than others who have not attained this level of education. This incentive to study longer enables strong economies to become technologically advanced countries. This is because, to a certain extent, human capital allows us to adapt better to technology, to catch up technologically and to develop a strong capacity for innovation, which ultimately contributes to improving our collective well-being.

Following the work of Mincer and other authors who have highlighted the important role of human capital in the improvement of private and global income, other authors have had the merit of criticizing and even placing limits on this positivism. To this end, Pritchett (2001), is radical in his work, asserting after empirical work that there is no association between increases in human capital attributable to raising the level of education of the workforce and the growth rate of output per worker. It starts from the observation that, in general, the best-educated people tend to be the best-paid. Once the demand for educated workers diminishes, this workforce is no longer productive, or even stagnates. Also, an education system can be weak so as not to produce people with high professional qualities, or even less productive people. Here, the diminishing returns to human capital are used as an example.

In this logic it is essential to propose alternatives that allow to make profitable the human potential. Thus, Boccanfuso et al.(2009), propose in their study to consider qualitative aspects in order to explain the improvement of human capital in economic growth. The elements included in their analysis include the public

investment rate, population growth rate, diminishing returns (number of years of study and wages per worker) and the quality of the education system (pupil/teacher ratio, public spending per pupil, share of public spending per pupil in GDP per capita, average teacher salary, etc.). Pritchett (2001), concerning him, highlights the political and institutional aspects capable of influencing human capital. Dessus (2000), about him, starts from the principle that building human capital through mass education, regardless of the country, would not bear fruit in terms of economic growth. There are three reasons why the mass education proposed by many countries is not always capable of generating growth: mass enrolment does not take into account the quality of education or of the education system, the unequal nature of its funding and the initial endowment of human capital. Barro (2001), in his study, not only highlights aspects relating to human capital, but goes further by showing that the improvement in economic growth cannot be explained simply by human capital, but would be the result of factors such as government spending, the degree of openness, inflation, the fertility rate, the investment ratio, trading conditions and the rule of law index. His study shows that economic growth is positively related to human capital if quality instruments are used. He also shows that grades in mathematics and science are significantly correlated with economic growth. This suggests that learners should be encouraged to take up these subjects.

Demographic ageing has three corollaries: an increase in the dependency ratio, an increase in life expectancy and a reduction in the size of the population. In this context, however, capitalization on ageing is possible, as many authors have suggested. This is the case, for example, of Scarth (2002), who shows that in a context of ageing, given that citizens are certain to live longer in retirement, they save more in the hope of benefiting as long as possible. In this case, savings imply that people have to work longer, and this leads to a demand for human capital training to improve labor productivity and thus work over the long term. We could also consider that in a context of ageing, if the improvement of human capital leads to an increase in GDP, as demonstrated by Han & Lee (2020), and Barro (1991), in their studies, it would be good policy to reduce spending in certain areas of the economy and invest them in human capital. This will have the long-term effect of offsetting age-related expenditure. Other authors have worked on productive ageing. These include Bloom & Sousa-Poza (2013), who teach us that older people possess skills and abilities, based on experience, that many younger workers lack. In this way, years of experience are made possible through continuous training, making older people more productive and keeping them in the labor market over the long term, thus helping to reduce the social costs associated with ageing. At the same time, companies can actively choose to take advantage of an older workforce by implementing retraining programs, adapting to different working hours, investing in workers' health and promoting early detection of illness. In addition, companies should foster work environments that encourage the continued productive participation of older workers, continues Bloom & Sousa-Poza (2013). Pelletan & Villemeur (2012), confirm this idea by prescribing an aging-rejuvenation. Their study shows that the age of onset of chronic diseases in developed countries rose

sharply in the 20th century, and this same trend is set to continue in the decades to come. Improved health up to a given age, and more specifically better health among the working population in developed economies, is conducive to an increase in the number of older people in working life. And if this length of working life is accompanied by ongoing training, ageing should no longer be seen as a burden on economic growth. Given that productivity has a lifecycle that stabilizes beyond the age of 40, according to studies including those of our previous authors, the challenge here is to remain productive for a long time, because if the years of activity in good health increase, productivity should also accompany this cycle. This is why training and adaptation cycles should be organized on an ongoing basis, bearing in mind that the oldest cohorts did not have long years of study.

The social aspects or non-economic benefits of human capital are another area of research that can improve social well-being. Lutz & Samir (2011), have proposed a study to show that access to education is totally beneficial for society in general and for families in particular. Education improves access to information, modifies behavioral motivations and enables citizens to better monitor their own preferences. Improving human capital also means a better-educated population, which contributes to socio-economic and political development. The human development index generally cited to analyze the social and economic progress of modern states has three interesting aspects. Of these, one measures progress in education per se and two others reflect progress in health and material well-being. The last two aspects are the consequence of education. This rightly demonstrates that the countries with a high human development index are the countries where human rights are respected. This is because access to information enables citizens to become peers in society, rather than subordinate leaders as in ancient times. The business index, which shows a state's ability to attract, facilitate and encourage business, is generally high in states with high human potential. The power of trade unions is another element that can be attributed to human capital, even if it cannot always be quantified economically.

5. Empirical analysis

5.1 Choice of variables and models

As stated in the introduction, our study analyses the productivity of human capital in relation to the costs of ageing. Here we present the variables selected in the analysis of our topic. Our dependent variable is aggregate salary growth defined annually. This is in line with what authors such as Mincer (1974), Krueger and Lindahl (2001), Han & Lee (2020), have analyzed by showing that wage income is the materialization of productivity in relation to the corresponding level of education. We chose the salary growth or variation variable (GROWTH_SALARY), since we were working with macroeconomic data, it made sense to use this figure, which covers all sectors of economic life. Our key variables are health care and pension expenditures as a percentage of GDP. The first (PENSIONS) covers general government pension expenditures. Our second key variable is total health care

expenditures (HEALTH_EXP). Also expressed as a percentage of GDP, it excludes spending on long-term care. Other control variables have been inserted into our work. GDP growth (GDP_GROWTH), which is important in macroeconomic studies. Fougère et al. (2005), show that in a context of ageing, a high number of elderly people is likely to slow GDP growth in the long term. In the short and medium term, however, due to a more experienced workforce, the quality of work and productivity are improved, which in turn improves GDP growth. In addition to these variables, we have inserted the variable employment rate by level of education (EDUC_EMP), which provides information on the activity rate of workers according to their level of education. We divide this variable into three categories: primary, secondary and tertiary. In our analysis, we will work on the last two categories. Mincer (1984), tells us that the demand for skilled labor leads to an increase in training. As additional years of education increase the productivity of the workforce, a higher wage will accompany this level of qualification. In addition, we will include the quality variable number of years of study (YEAR_STUDY) as in Hanushek and Kimko (2000), Barro and Sala-i-Martin (1995), Barro (2001) and Benhabib and Spiegel (1994). We believe that the number of years of study determines productivity, which is reflected in improved pay. Given that we are working in a macroeconomic context, it is obvious that the business environment is important in improving productivity. We have therefore included in our regression, as in Barro (2001), the rule of law (RULE_LAW). This is an enduring set of laws, institutions, standards and national commitments. These include respect for the law by public officials, respect for human rights and due process, openness of government and access to independent justice. This variable is expressed as a percentile, where countries with a figure close to 100 are at the top of the list of countries where human rights are respected. If it is close to 0, this would mean that human rights are almost non-existent. Close to the rule of law variable, we will also insert the variables political stability (STAB_POL) and corruption control (CONT_CORRUP) which analyze and capture the same effects as the rule of law variable. Other additional variables are also introduced into our regression. For instance, we have introduced the demographic dependency ratio (DEP_RATE) given that we are working on a subject related to demographic ageing. In many studies, it is likely to have a positive influence on salary variation. This is because, in a context of ageing, with a low fertility rate, investment in education is likely to increase, leading to an increase in the quality of training, which in turn translates into higher wage income. This is one of the hypotheses put forward by Fougère et al. (2009). We will propose other demographic variables, in particular the total dependency ratio (RATIO_DEP_TOT) in our study. Working in the field of public finance, we propose to insert government public expenditure (PUB_EXP) as a percentage of GDP. We have also included the technological variable (TECHNOLOGY) in our assignment, since we believe that productivity improvement is correlated with access to technology, or at least with the adaptation of technology to current occupations. Here, we have chosen for a data availability concern to include internet access that materializes through the use of phones, tablets, computers and others.

And, given that today's working environment is heavily influenced by technology, we have included the percentage of the population with access to the internet. Furthermore, in Barro (2001), the productivity of human capital is also and above all a question of trade openness which is materialized by imports and exports. In our assignment we will integrate the variable trade openness (CUR_ACC) which is represented here by the trade balance, i.e. the difference between imports and exports. Other additional variables are also introduced into our regression. These are inflation (INFLATION), which is the increase in income levels. In principle, it should have a positive influence on wage earners. In this sense, in a period of inflation, in order to maintain people's purchasing power, wages are aligned with the standard of living, which increases salary. Other variable included in the regression is savings (SAVINGS). Considered as investment, it is likely to influence wage income.

Our first model takes the following form:

$$\mathbf{SALARY}_{growth} = \beta_1 \mathbf{SALARY}_{growth}(i,t-1) + \beta_2 \mathbf{PENSIONS}_{i,t} + \beta_3 \mathbf{X}_{i,t} + \beta_4 \mathbf{Z}_{i,t} + \mu_{i,t} \quad (1)$$

Where β_1 is a salary variation, which reflects the increase or decrease in salary at the aggregate level of OECD countries. β_2 refers to pensions, which represent government spending to meet pensions this as a percentage of GDP. The other variables are control variables that stabilize our model. The β_3 variable includes macroeconomic and fiscal variables. These include GDP growth, the overall savings rate, annual inflation and government expenditure as a percentage of GDP. The β_4 variable includes governance variables such as the rule of law, corruption control and the absence of conflict indicator. All these variables are expressed in percentiles, where countries with a score of 100 mean that their governance indices are close to perfect. Conversely, countries with a score close to 0 indicate poor business environment, which would have a strong impact on improving productivity.

Our second model takes the following form:

$$\mathbf{SALARY}_{growth} = \beta_1 \mathbf{SALARY}_{growth}(i,t-1) + \beta_2 \mathbf{HEALTH_EXP}_{i,t} + \beta_3 \mathbf{X}_{i,t} + \beta_4 \mathbf{Z}_{i,t} + \mu_{i,t} \quad (2)$$

Where β_1 , β_3 , and β_4 are the same variables already reported above. Health expenditure is represented by β_2 and is government expenditure on health carried forward to GDP. These do not include long-term healthcare expenditures.

The table below shows the descriptive variables of our regression. They are fairly stable. Our dependent variable is fairly disparate. The salary variation variable has a negative minimum and a positive maximum, which shows that over time there can be a reduction in wages depending on the economic context. Other variables follow more or less the same trend.

Table 1: Descriptive statistics

	N	Mean	Standard-deviation	min	max
SALARY_VARIATION	690	3.533324	3.737132	-10.90553	34.7964
PENSIONS	651	9.215295	3.695352	1.078	17.9
HEALTH_EXPENDITURE	680	8.58649	2.082144	3.898	16.844
GDP_GROWTH	693	4.307808	4.949553	-22.60013	34.75724
EMPLOYMENT_RATE_SECOND	666	84.49592	3.736869	68.54	94.13
EMPLOYMENT_RATE_ACADEMIC	645	75.1155	5.66535	54.07	89.75
SAVINGS	662	6.736831	5.873024	-12.8465	27.50576
INFLATION_RATE	693	2.134125	1.962064	-1.692643	15.25345
GENERAL_EXPENDITURE	693	43.67434	7.11888	23.68063	65.10932
RULE_OF_LAW	660	86.68581	11.32053	55.76923	100
POLITICAL_STABILITY	660	74.7497	19.5019	7.109005	100
CORRUPTION_CONTROL	660	84.72888	13.00085	52.60664	100
DEPENDENCE_RATE	692	24.43898	5.386732	10.07	48.71
CURRENT_ACCOUNT	665	.1550823	5.691837	-22.66612	16.39999
INTERNET_ACCESS	690	68.78476	22.36148	6.319062	99.50494
ACTIVITY_RATE_65-69 YEARS	685	17.73032	12.52013	1.078685	55.56751
ADDED_VALUE_GROWTH	658	1.827391	2.578637	-6.037456	20.12957
TOT_DEPENDENCE_RATE	690	50.16913	5.384277	36.19	68.85
POPPULATION_65 YEARS+	693	16.20058	3.226596	7.2	28.9
POPPULATION_80 YEARS+	693	4.116883	1.196595	1	9.3
AVERAGE_YEAR_STUDY	375	11.98589	1.436818	6.78	14.26

5.2 Interpretation and results

The results of our first regression are reported in Table 2 below. Our dependent variable is salary variation. Our regressions are realized with state.

Table 2: Regression's results with pensions as key variable

VARIABLES	Reg.1	Reg.2	Reg.3	Reg.4	Reg.5	Reg.6	Reg.7	Reg.8	Reg.9
SALARY_VARIATION (L-1)	0.113*** (0.029)	0.085*** (0.029)	0.078*** (0.026)	0.170** (0.068)	0.109*** (0.028)	0.073** (0.029)	0.107*** (0.023)	0.120*** (0.040)	0.067** (0.028)
PENSIONS	-0.250*** (0.065)		-0.245*** (0.053)	-0.155** (0.066)	-0.225*** (0.063)	-0.256*** (0.064)	-0.251*** (0.065)	-0.242*** (0.060)	-0.250*** (0.068)
GDP_GROWTH	0.406*** (0.085)	0.430*** (0.084)	0.379*** (0.087)	0.525*** (0.049)	0.417*** (0.085)	0.434*** (0.087)	0.405*** (0.081)	0.367*** (0.086)	0.425*** (0.082)
EMPL_RATE_SECOND	0.005*** (0.001)	0.005*** (0.001)			0.005*** (0.001)	0.002* (0.001)	0.004*** (0.001)		0.002*** (0.001)
RULE_OF_LAW	-0.070*** (0.014)	-0.054*** (0.016)	-0.059*** (0.017)	-0.022 (0.022)			-0.067*** (0.013)	-0.067*** (0.016)	
DEPEN_RATE	0.127*** (0.044)	0.023 (0.029)	0.094*** (0.031)	0.127** (0.055)	0.121** (0.044)	0.147*** (0.044)	0.156*** (0.044)	0.128*** (0.033)	0.165*** (0.043)
INFLATION	0.692*** (0.173)	0.768*** (0.177)	0.683*** (0.171)	0.781*** (0.261)	0.693*** (0.171)	0.772*** (0.168)	0.408* (0.224)	0.432* (0.243)	0.479** (0.217)
SAVINGS	-0.005 (0.021)	-0.005 (0.021)	-0.017 (0.021)	-0.016 (0.019)	-0.008 (0.020)	-0.040* (0.021)			
GEN_EXPEN		-0.050** (0.019)							
EMPL_RATE_ACC			0.007*** (0.001)						
AVERAGE_YEAR_STUDY				0.228** (0.096)					
CORR_CONTROL					-0.055*** (0.010)				
POLIT_STABIL						0.005 (0.006)			
CURRENT_ACC							-0.078** (0.029)	-0.107** (0.041)	-0.087** (0.035)
HIGH_EDU_EXP								1.379*** (0.445)	
INTER_ACCESS									-0.017 (0.011)
CONSTANT	3.877*** (1.308)	4.883*** (1.462)	3.582** (1.602)	-3.272* (1.612)	2.430** (1.072)	-2.018** (0.792)	3.699** (1.298)	3.716* (1.807)	-0.607 (1.409)
OBSERVATIONS	542	572	559	335	542	542	545	447	560
R_SQUARE	0.588	0.556	0.618	0.623	0.584	0.561	0.554	0.532	0.537
YEARS	20	20	20	20	20	20	20	19	21

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Our regressions provide results that we can comment on. Our basic model is presented in regression 1 of the table. After testing for collinearity, heteroscedasticity and model choice, we opted for a least squares regression with fixed effects. Our regressions are carried out with the standard robustness of errors, which is done in Stata with the "r" command.

In regression 1, our lagged dependent variable (SALARY_VARIATION (L-1)) is positive at the 1% threshold, which tells us that the current year's salary is not very independent and is therefore highly correlated with the previous year's salary. Our key variable (PENSIONS) is significantly negative at the 1% level. A one percentage point increase in pension expenditure reduces earnings by 6%. This is possible since when spending on care for the elderly increases, the government tends to use the fiscal lever by raising taxes on labor, which reduces the net wages of workers. The second variable, GDP growth (GDP_GROWTH), was found to be positively correlated with the variation in wages at the 1% threshold. This shows a strong relationship between GDP growth and productivity. In fact, 1% GDP growth leads to a 4.9% increase in salaries. This is entirely logical in the sense that when the economy is booming, investment increases, companies are more motivated to

recruit, and since the primary incentive for hiring is salary, the latter is likely to increase considerably. This in turn contributes to improving GDP growth via the economy's overall productivity. Dessus (2000), shows that the quality of the education system, leading to a good education, contributes to GDP growth via the productivity resulting from well-trained human capital, in contradiction with Pritchett (2001), and Caselli et al. (1996), who would tend to see the opposite. The variable Rate of employment with secondary education (EMPL_RATE_SECOND) showed positive significance at the 1% threshold. This result is consistent with our research insofar as a large proportion of employees in OECD countries have a secondary education qualification. This is also the required qualification to continue their studies at tertiary level. El Mahjoubi (2015), showed a role for secondary education in her studies for the Morocco's case, we can associate this result with our research concerning OECD countries. This result answers our question as to whether improving human capital contributes to the stability of so-called ageing expenditure. As the education variable is positive, this shows that it contributes to salary improvements, and if wages are increasing, the taxes generated on salaries will contribute to the sustainability of ageing expenditure. The rule of law variable (RULE_OF_LAW) showed negative significance in our model. Its negative sign calls for an in-depth study. We would have expected it to be positive. Since in a context where human rights are respected, living conditions would be better, resulting in better working conditions and wages. The demographic dependency ratio variable (DEPEN_RATE) is positively significant at the 1% level. This is a convincing result. Indeed, in a context of ageing, as we have noted, the birth rate is reduced as is the death rate, so that the young cohorts born into it are better trained. This is one of the conclusions reached by Pelletan & Villemeur (2012). In fact, increased longevity increases the incentive to train. And, since the return on investment is made over a longer period, individual productivity and GDP growth are improved. Since people are better trained, companies are more inclined to attract the best one, which in turn helps to increase salaries. The inflation variable (INFLATION) in our regression was found to be significantly positive at the 1% level. This is in line with the literature. Indeed, an increase in inflation leads to an increase in salaries, which helps to adjust purchasing power and keep the economy stable. The last savings rate variable (SAVINGS) did not show any significance. We would have expected its sign to be positive, but in this case it turned out to be negative. In fact, in a situation where savings are increasing, the economy opts for investments that are not only tangible, but also intangible. This helps to boost training.

In regression 2, we have inserted the general expenditure variable (GEN_EXP). Here the significance is negative at the 5% level, which supports our first regression on expenditure on pensions. Since pensions are part of government expenditure, logically they have the same sign. A one percentage point increase in government spending reduces wages by 0.019%. In regression 3, we inserted the higher education employment rate variable (EMPL_RATE_ACADEMIC), which captures the employment rate of workers with a higher education qualification.

Unsurprisingly, our variable is significantly positive at the 1% threshold. This shows that as the university is the place where training is at its peak, the demand for skilled labor leads to better wages. In regression 4, we inserted the variable average years of education (AVERAGE_YEAR_STUDY). Our variable is significantly positive at 5% threshold, which confirms the results of literature. Indeed, theorists of the human capital productivity recognize beyond debate the role of education in the productivity of human capital. This is what Mincer (1974) and later Krueger and Lindahl (2001) called opportunity costs. Showing that an additional year of study leads to a substantial gain in salary. In regression 5, we inserted another governance variable, control of corruption (CORRUP_CONT). Here, the variable is significantly negative as in the case of the rule of law, which is a curiosity in our work. In regression 6, we introduced political stability (STAB_POL), which here refers to the absence of war, terrorism and political conflict, among other things. this variable did not show any significance. Perhaps this is a sign that political stability is the rule in OECD countries. In some studies, tests of this type have been significant. In regression 7, we introduced the trade balance variable (CUR_ACC), which represents the difference between imports and exports. Our variable is negatively significant, which is also surprising. We would have expected it to be positive, insofar as trade openness tends to favor trade with the outside world, which paves the way for foreign-oriented investment and high capital mobility. Perhaps this is a sign that the local market is being protected, thereby protecting employees against potential competition from outside. In regression 8, we inserted the higher education expenditure variable (HIGH_EDU_EXP), which is a qualitative variable that analyses expenditure on higher education as a percentage of GDP. Here we obtained a positively significant result at the 5% threshold. Expenditure on education, including higher education, has been proposed by several authors such as Manuelli and Seshadri (2014) and You (2014). You (2014), for instance, shows that state investment has greatly contributed to the promotion of quality of work in the United States. This result is in line with our research, which shows that increased spending on education improves the quality of teaching and enables people who have acquired better knowledge to compete for high-potential jobs and therefore higher salaries. In regression 9, we included the Internet access variable (INTER_ACCESS), which here reveals the degree of Internet penetration in the economic system of OECD countries. The latter showed no significance. This suggests that as OECD countries are in the 4rd phase of the technological revolution, the level of internet penetration is no longer a concern in the economic system of these countries. The results of these analyses are interesting insofar as most of the results obtained are in line with the literature.

Table 3 below shows our regressions, where our dependent variable is still annual salary variation and our key variable is health spending as a percentage of GDP. We have focused here on the demographic variables, since the debates on demographic ageing and health spending are not entirely clear-cut.

Table 3: regression's results with health expenditure as key variable

VARIABLES	Reg.1	Reg.2	Reg.3	Reg.4	Reg.5
SALARY_VARIATION (1-1)	0.126**	0.132**	0.126**	0.125**	0.135**
	(0.055)	(0.058)	(0.055)	(0.056)	(0.057)
HEALTH_EXPENDITURE	-0.221***	-0.225***	-0.216***	-0.234***	-0.209***
	(0.071)	(0.074)	(0.070)	(0.076)	(0.067)
GDP_GROWTH	0.494***	0.483***	0.495***	0.493***	0.480***
	(0.038)	(0.036)	(0.038)	(0.037)	(0.037)
AVERAGE_YEAR_STUDY	0.456***	0.416***	0.449***	0.483***	0.379***
	(0.091)	(0.098)	(0.090)	(0.098)	(0.083)
RULE_OF_LAW	0.020	0.018	0.022	0.020	0.016
	(0.027)	(0.028)	(0.027)	(0.027)	(0.028)
DEPENDENCE_RATE	0.080**				
	(0.030)				
INFLATION	0.597**	0.612**	0.596**	0.620***	0.598**
	(0.211)	(0.222)	(0.211)	(0.211)	(0.214)
CURRENT_ACCOUNT	-0.166***	-0.167***	-0.165***	-0.174***	-0.158***
	(0.040)	(0.042)	(0.039)	(0.043)	(0.041)
TOTAL_DEPENDENCE_RATE		0.040			
		(0.028)			
POPULATION_65 YEARS+			0.124**		
			(0.047)		
POPULATION_80 YEARS+				0.375**	
				(0.161)	
Activity_Rate_65-69					0.015
					(0.014)
Constant	-7.451***	-6.692***	-7.584***	-7.278***	-4.445**
	(2.124)	(2.286)	(2.122)	(2.440)	(1.665)
OBSERVATIONS	341	341	341	341	341
R_SQUARE	0.641	0.637	0.640	0.640	0.636
YEARS	20	20	20	20	20

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Regression 1 is our basic model. Here, as in Table 3, we note that the lagged variable of our dependent variable is significantly positive at the 5% threshold. So, as in the previous model, the salary of the previous year determines that of the following year. The health expenditure variable (HEALTH_EXPEN) is also significantly negative at the 1% threshold, as in the pension expenditure regression. We note here that a one percentage point increase in healthcare costs leads to a 0.07% reduction in salary. This shows that if healthcare costs increase, the burden will tend to fall on working people and their salaries will have to be cut via taxation to cover these needs. This result can also be interpreted in other direction. Indeed, when wages increase, citizens tend to invest in improving the health system by subscribing to complementary health care, which in turn will improve individual and collective

health and, by the same token, productivity. As studies by Fogel (2005) quoted by Pelletan and Villemeur (2012) have shown, productivity can also be quantified by the good health index, which gives citizens better conditions to work harder. The GDP growth variable (GDP_GROWTH) is also significantly positive, as in the regression in Table 2. This translates into the fact that the improvement in GDP is beneficial to all sectors of the economy when the economy is booming. The average years of education variable (AVERAGE_YEAR_STUDY) was found to be significantly positive at the 1% level. As in the literature, the number of years of study is significant in relation to salary gain. The rule of law variable (RULE_OF_LAW) in our model was found to be insignificant. The demographic dependency ratio (RATIO_DEP) here proved to be positively correlated, and is significant at the 5% threshold. The inflation variable (INFLATION) in this other regression is also significant and positive at the 5% threshold. Although its significance is low compared with the regressions in table 2, we note that the signs are the same, which gives us confidence in our models. As in the previous table, trade balance variable (CUR_ACC) proved to be significant and negative, this time at the 5% threshold. As mentioned above, we focused on the demographic variables in the rest of our analysis.

Thus, in regression 2 we inserted the total dependency ratio variable (TOT_DEPEN_RATE). This variable did not prove to be significant. In regression 3, we inserted the variable population over 65 (POP_65 YEARS+). It is important to check the effect of an older population when analyzing the wage mechanism. In this case, our model turned out to be curiously significantly positive, and this can be explained, as we have shown, by an improvement in human capital. In regression 4, we inserted the population variable for the over-80s (POP_80 YEARS+). Like the population variable for the over-65s, this too is positive at the 5% threshold. In regression 5, we inserted the activity rate variable for the 65 to 69 age group (Activity_Rate_65-69), which is generally the age at which most Western countries are considering the retirement age. Here, our regression proved insignificant. What we take away from our regressions is that they are similar in terms of results. However, it is interesting to analyze some specific elements to have a deep idea of our analysis.

5.3 Specific analysis

Having observed that our key variables (spending on pensions and healthcare) have an impact on salary variation, we are entitled to take a closer look at how this would be affected if the workforce had a certain level of education. To do this, we wanted to analyze the situation in which the categories of workers had an upper secondary or academic qualification. this participation rate of upper secondary and university graduates interacts with our key independent variables in order to capture the impact of these workers with pension and health care expenditures on salary variation. our models are as follows.

$$SALARY_{growth} = \beta_1 SALARY_{growth}(i,t-1) + \beta_2 PENSIONS_{i,t} + \beta_3 X_{i,t} + \beta_4 Z_{i,t} + \beta_5 V_{i,t} + \mu_{i,t} \quad (2)$$

Where β_5 is the interaction variable between pension expenditure and workers with an upper secondary education on the one hand, and workers with a university degree on the other. Other variables are the same as those used in model 1 above. Other tests are also proposed, notably pension expenditure squared, in order to measure the panic effect. Our results are shown in the following table, which we will interpret.

Table 4: some results using interaction variables with pensions

VARIABLES	Reg.1	Reg.2	Reg.3	Reg.4
SALARY_GROWTH (1-1)	0.109*** (0.0234)	0.106*** (0.0233)	0.107*** (0.0237)	0.105*** (0.0231)
GDP_GROWTH	0.400*** (0.0817)	0.409*** (0.0814)	0.414*** (0.0808)	0.383*** (0.0823)
EMPLSECSUP	0.129*** (0.0182)	0.159*** (0.0183)	0.145*** (0.0178)	0.123*** (0.0195)
RULE_OF_LAW	-0.0721*** (0.0130)	-0.0717*** (0.0129)	-0.0714*** (0.0128)	-0.0746*** (0.0133)
DEPENDENCE_RATE	0.151*** (0.0438)	0.128*** (0.0402)	0.117** (0.0417)	0.175*** (0.0434)
INFLATION	0.394* (0.222)	0.398* (0.222)	0.407* (0.220)	0.387* (0.223)
CURRENT_ACCOUNT	-0.0771** (0.0283)	-0.0754** (0.0281)	-0.0761** (0.0281)	-0.0781** (0.0285)
PENSIONS	-0.236*** (0.0642)			
INTER_PEN_SEC_EMP		-0.00265*** (0.000814)		
INTER_PEN_ACC_EMP			-0.00216*** (0.000707)	
PENSIONS2				-0.0158*** (0.00338)
CONSTANT	-4.377** (1.707)	-6.478*** (1.563)	-5.386*** (1.595)	-4.832** (1.740)
OBSERVATIONS	545	545	545	545
R_SQUARE	0.557	0.552	0.550	0.571
YEAR_NUMBERS	20	20	20	20

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 4 presents some interesting results, which we will be able to comment. Regression 1 in our table is our basic model, which has already been proposed above. In regression 2, we have included the interaction variable pension expenditure and workers with upper secondary education. Our variable is negatively significant at

the 1% level. The lesson here is that, compared with the basic model, we note a lower incidence of wage earners when the worker has an upper secondary education. In regression 3, we have inserted the interaction variable pension expenditure and workers with an academic degree. The same result is obtained with even less impact. In other words, workers with higher education are less affected if pension expenditure increases. This is because the latter, being more productive, is remunerated at its fair value, and regardless of the tax levy for the care of the elderly, the latter remain less affected. This is a sign that we need to encourage training leading to qualifications, particularly in areas of high demand in the labor market. In regression 4, we have inserted the variable pensions squared. Our variable is significant at the 1% level, but does not have a particularly strong impact compared to the pensions variable in the base model. This could be explained by the fact that taxation has a maximum deduction threshold for the worker, so that if this threshold is exceeded, it could lead to discouragement of work or the exile of workers to countries with low deductions, which would contribute to paralysis in the worker's country of departure. So even if spending on pensions were to explode, the public authorities would manage not to overtax workers.

We have also done the same exercise for health spending. Our model takes the following form

$$\mathbf{SALARYgrowth} = \beta\mathbf{1 SALARYgrowth}(i,t-1) + \beta\mathbf{2 HEALTH_EXPI,t} + \beta\mathbf{3Xi,t} + \beta\mathbf{4Zi,t} + \beta\mathbf{5Vi,t} + \mu\mathbf{i,t} \quad (3)$$

Where $\beta\mathbf{5}$ is the interaction variable between health expenditure and workers with an upper secondary education on the one hand, and workers with a university degree on the other. Other variables are identical to model 2 above. The results are presented in the following table. Other variables are included in our regression, such as health expenditure squared.

Table 5: some results using interaction variables with health expenditure

VARIABLES	REG.1	REG.2	REG.3	REG.4
SALARY_GROWTH (1-1)	0.126**	0.135**	0.134**	0.130**
	(0.0546)	(0.0559)	(0.0562)	(0.0538)
GDP_GROWTH	0.494***	0.510***	0.504***	0.501***
	(0.0382)	(0.0386)	(0.0386)	(0.0376)
AVERAGE_YEAR_STUDY	0.456***	0.466***	0.468***	0.481***
	(0.0914)	(0.0899)	(0.0924)	(0.0935)
RULE_OF_LAW	0.0205	0.0149	0.0175	0.0150
	(0.0270)	(0.0284)	(0.0280)	(0.0262)
DEPENDENCE_RATE	0.0798**	0.0882**	0.0825**	0.0727**
	(0.0298)	(0.0312)	(0.0322)	(0.0281)
INFLATION	0.597**	0.610**	0.610**	0.603***
	(0.211)	(0.214)	(0.213)	(0.210)
CURRENT_ACCOUNT	-0.166***	-0.155***	-0.160***	-0.167***
	(0.0397)	(0.0392)	(0.0404)	(0.0401)
HEALTH_EXPENDITURE	-0.221***			
	(0.0712)			
INTER_HEALTH_SEC_EMP		-0.00186*		
		(0.000963)		
INTER_HEALTH_ACC_EMP			-0.00208**	
			(0.000878)	
HEALTH2				-0.00950***
				(0.00303)
CONSTANT	-7.451***	-8.129***	-7.878***	-8.306***
	(2.124)	(2.332)	(2.322)	(2.305)
OBSERVATION	341	336	337	341
R_SQUARE	0.641	0.635	0.637	0.639
YEARS_NUMBER	20	20	20	20

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

In table 5, regression 1 is our basic model, to which we will no return further. In regression 2, the interactive variable health expenditure and high school graduate is negatively and weakly significant at the 10% threshold. This suggests that, in the context of health expenditure, the salary effect is weakly explained in relation to the worker's level of education. Nevertheless, the effect remains weak because the coefficient in relation to the health variable in the basic model remains low. The same observation can be made when we include in regression 3 the interaction variable of health expenditure and workers with higher education qualifications. Here our variable is significant at the 5% threshold, which shows in effect that the incident remains the same. In other words, education needs to be encouraged when the authorities are counting on labor productivity to revive the economy. That's why the Study Committee on Ageing of Belgium's High Council of Finance regularly issues analyses aimed at improving productivity in order to meet the costs of ageing. In regression 4, we inserted the squared health variable. Our variable is significant,

but we can see that it does not create a panic effect. This can be explained, as we said earlier, by the fact that taxation has a threshold for the worker, and so exceeding this threshold would be counterproductive for fiscal policy. Further, given the rapid increase in healthcare expenditure, it can be financed by other mechanisms, rather than by the worker alone, such as income-generating investments.

6. Conclusion

At the end of our analysis, we discussed the impact of human capital productivity on the so-called ageing expenditure. In other words, it was a question of verifying whether human capital productivity could constitute a solution in a context of demographic ageing. Human capital, which is the accumulation of formal skills through education and informal skills through training, is undoubtedly one of the levers that should be used by states that are already experiencing a slowdown in the birth rate, coupled with a growing number of elderly people. An analysis of the human capital concept has enabled us, through many authors who have tried it (Adam Smith, Mincer, Schultz, etc.), to shed light on an expression that dates back to the dawn of time, but whose relevance is still relevant today. Variables used to quantify human capital, on the other hand, are the subject of much debate. While past centuries have focused on the quantitative, i.e. the number of educated people, the average number of years spent studying and so on, other studies have emphasized the qualitative as well as the quantitative. For example, many authors will focus on investment in human capital, such as the number of teachers per pupil or the number of pupils per class. The quality of human capital is the key to profitability in terms of productivity. With better training, knowledge-holders are better equipped to face economic challenges. The productivity of human capital has been studied using several approaches. The value added of working people seemed to us to be the most appropriate for analyzing it, because the output of a person with x number of skills manifests itself in the productive capacity of that person. However, working with macroeconomic data, we opted for salary income. The latter, like value added, reflects the remuneration of production as a function of skills of the owner. This variable is interesting because it determines wage trends at national level in a given year. The aim is to show that salary increases that go hand in hand with productivity can generate added value in the financing of so-called age-related expenditure. In this work, we focused on spending on pensions and healthcare as a percentage of GDP. Other control variables were included in our regressions. These include governance variables, i.e. control of corruption and trade openness. Other additional variables were the demographic dependency ratio, inflation, the savings rate and government spending. Results show a negative and significant relationship between salary variation and our key variables. This would imply that the "ageing" expenses, once they increase, tend to lead to a reduction in salaries. This means, for example, that the more the expenditure on pensions due to a large number of persons to be covered, the salary is reduced via taxation on persons in employment to cover this social category. The same can be seen in health care spending. In other words,

net salaries are likely to be reduced when a population is experiencing demographic ageing, because the cost of care, staff costs and so on is also a matter for fiscal policy. This reduction in salary could also be interpreted differently. In fact, in order to improve individual health, once the salary increases, the worker can take out other forms of insurance, which will tend to reduce the net salary. However, the educational variables, in particular the average number of years of education, are positively significant. This would mean that the more years spent in education, the higher the wage return. This is interesting. Insofar as the greater the proportion of the population that is educated, the wages that accompany these years of study will be significant and the public authorities will have a large number of assets on which to levy taxes, among other things, which will ultimately be used to look after the elderly. The governance variables, in particular the rule of law, turned out to be negative in our regression. We would have expected this to be positively significant, as in many studies. This deserves particular attention. Given that the education variables are significantly positive with wage growth, it is fair to say that an educated population will improve its human capital and prove to be more productive. And if the latter is more productive, the wage increase will go hand in hand with this well-educated workforce, which will at the same time make it easier for the public authorities to levy taxes on workers.

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