



DEMOGRAPHIC TRANSITION SURVEY:

Theories and Impacts

*A review of literature produced by the
Demographic and Economic Transitions
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Introduction

Aging economics emerged about 40 years ago. It was in the 1970s that Martin Feldstein and several others stated the problem of an aging economy in terms of financial transfers between households and the balancing of pension programs. This research, which was soon supplemented in microeconomics by the Modigliani and Miller life cycle theory, initiated a worldwide movement for interest in demographic balance, intergenerational transfers, and the consequences of the growing aging phenomena. As of this period, Japan became the leading example, as they were the most advanced in population aging. The deep and lasting Japanese financial crisis had, at that time, demonstrated use of voluntarist policies to manage aging. In fact, as we know today, according to *Nicole Maestas, Kathleen Mullen, and David Powell*, that population aging will provoke a reduction in growth by 1.2% per year in the United States between 2010 and 2020, and a 0.6% per year decrease between 2020 and 2030.

Hopes for the Silver Economy as a source of business creation and an increase in labor ended in disappointment. Market segments remain small and behaviors adapt more rapidly than average aging. This naïve vision is reinforced by evolving debates. Before the 2007 crisis, many thought that pension systems depended on 3 pillars: social security, business funds, and private savings. Thirty years and several financial crises later, it must be admitted that the overwhelming majority of the population benefits only from social security. In the United States, for example, a recent publication by J. Poterba and D. Wise shows that 40% of the elderly have very little in savings and pensions and depend only on social services. Lengthening working life in order to reduce dependency costs was tested in numerous countries. However, it obviously clashes with job market constraints and greatly diminishes the possibility of private, informal transfers between generations. Bernard Hammer et. al. insist on the importance of non-monetary intergenerational transfers to in order to decide new public policies.

All the literature might be announcing a loss in potential growth caused by the age structure of the population, but economic policies designed to counteract this trend have not yet been clearly identified and the recommendations are limited to advocating for a postponement of the retirement age. Ronald Lee, with a more original position, suggests massive investment in education and technology in order to compensate for aging and an increase in dependency rates through improved productivity.

The coming years will be marked by numerous experiments in economic policy in the aging sector. These orientations will affect all markets and economic activities, and therefore it is important to understand what has already been explored and what can be used as a basis for formulating new orientations for public and private decision-makers.

2. What is the Demographic Transition?

The demographic transition (Chenais, 2010) is the transition from an old, quasi-high-balanced system (high mortality, high reproduction) to a modern, quasi-low-balanced system (low mortality, low reproduction).

1.1 Measuring and Predicting Aging in France, Europe, and Worldwide

The 21st century will be marked by the aging of the world's population. Transition demographics reveal a transformation of the age pyramid. In some big western cities (Germany, Northern Italy), this will manifest itself by continued low birth rates and a significant prolongation of life expectancy. The number of elderly could soon surpass the number of youth, as already observed in certain western cities (Chenais, 1986). Nearly one short century ago, in 1921, the number of elderly in the total population was 15 times less than what it is today. This aging progresses more or less quickly, according to the demographics of each country. France is a country in slow transition, as opposed to Mexico and Kenya, countries in explosive transition. The portion of senior citizens in the population could be multiplied by 100 in Mexico and by 200 in Kenya at the outcome of the transition process. At the beginning of 2100, the upheaval of the age pyramid could be such that the octogenarians could surpass the under-20s. Following predictions made by Auguste Landry (1905), post-transitional birth rates remain greatly inferior to the rate of generational replacement, instituting an unheard-of situation: an increasing deficiency of younger generations and a rapid growth in senior citizens.

These predictions draw attention to the changing lifestyles of modernizing societies in which the cost of aging is little by little transferred from the family to the State. These unprecedented upheavals should call upon governments to integrate these new pressures into their long-term budget strategies for public accounts.

1.2 Demographic Transitions and Public Finance

The demographic growth slow-down makes financing public works more costly. Population aging has significant consequences on financing and the public sector. As a result, one of the principal roles of the public sector consists of reassigning resources throughout the life cycle. The weight of required levies increases with age, peaks, then falls. Since in most countries taxes are based on income, this weighs mainly on working-age adults. The main beneficiaries of these services are children and the elderly.

The impact of aging should manifest in an increase in public spending. According to the European Commission, public spending resulting from aging will increase by 4.6 GDP points by 2060 within the EU. This evolution would encounter significant disparities between the different member states (+9.4 GDP points for the Netherlands; +5.1 points for Germany). France, with Italy and Sweden, would be one of the member states least affected by this dynamic, with an increase in public spending of only 2.2 GDP points. Questions about financing the necessary levies to cover the additional spending tied to the demographic transition will have a different acuity according to the increase in purchase power of income earners and capital owners. In other areas, the effect of the decreased working age population will surely bring about an increase in employment, but the potential growth would be slowed down by 1.8% per year in Europe.

In the absence of new measures targeting age-related spending, the budgetary weight of the latter would increase progressively, but disparately, depending on the country. In an ideal situation wherein deficits would be maintained at relatively stable levels (2.2% on average) until 2020, they would then progress to 9.2% of the GDP in 2050. This increase would be more significant for emerging economies (11% on average) than for advanced economies (8% on average).

In France, the number of dependent senior citizens would increase from 27.9% of the population to 43.7% between 2013 and 2050 (as compared to 57.4% in Germany and 52.9% in Italy). Transfers to senior citizens were evaluated at 26.1% in 2015, one of the highest rates in the world. This will stabilize by 2050 at around 23.5%, behind but close to the projections made for Norway, Brazil and Finland. Politics being equal, the public debt would attain 166% of the GDP in 2050 (S&P study, 2016).

1.3 Aging Well: Definitions and Theories

The *Aging Well* concept is based on a variety of ideas, including life satisfaction, longevity, not suffering from handicaps, controlling one's life, being active, and being independent (Moody, 2005). It is the opposite of aging poorly. This distinction recalls two conceptions on aging in our society: a positive one in which aging means experience, wisdom and self-realization, versus a negative conception that associates aging with senility and dependency (Dodeller and Le Bihan, 2015).

In industrialized countries, those interviewed connected aging well with physical health. Conversely, in the little or non-industrialized regions of Africa, material security was prioritized (Fry et al. 2007). However, there is no clear dichotomy between the concept itself in industrialized countries and in developing countries. The inhabitants of an impoverished city in an industrialized country, therefore, give primordial importance to material security. In Ireland and the United States, the qualities that go hand in hand with aging well are satisfaction, internal peace, tolerance, the ability to reflect, the freedom to do what one wants, being active, participating in social life, and vitality.

Independently of the rural or urban lifestyle of those interviewed, definitions of aging well and aging poorly evolve as a function of age (Lewis, 2010). As for the actions that individuals have undertaken to age well, they observe the lifestyle of a person who serves as a role model (generally parents or grandparents), and take inspiration from it. Aging well is characterized by the personal responsibility and conscious decision to live and lead a healthy life. This emphasis on a healthy life finds its origins in the willingness to serve as a model for younger people (within the family but also in the wider community). While the younger population emphasizes physical and mental health, the elderly envision mental well-being and a role in society. It should be noted that access to health care or quality health care is not mentioned as a condition for aging well (Apouey, 2015). As for aging poorly, younger people define it as the presence of chronic illnesses, whereas older people emphasize the fact of not taking care of oneself and having a negative attitude towards life in general.

During the 2000s, the Rowe and Kahn's theoretical approach was confronted by a more subjective approach to aging well (Strawbridge et. al., 2002). Comparing aging well according to the Rowe and Kahn criteria (absence of illness, handicap and risk factors; maintenance of good physical and mental functions; active engagement in life) to self-declared (subjective) aging criteria well shows that a large portion of those who consider themselves to be in good health are not, according to Rowe and Kahn. Thus, the self-declaration of aging well largely

correlates to well-being, rather than to an aging well that can be objectively qualified (Strawbridge et al, 2002).

Finally, an analysis spreadsheet of aging well was established during the 2000s based on 10 criteria (Depp and Jeste, 2006). In their study, *Definitions and predictors of successful aging: a comprehensive review of larger quantitative studies*, the authors establish a tree of aging well based on 10 factors:

- Handicap / physical health;
- Cognitive function;
- Life satisfaction / well-being;
- Social engagement;
- Illnesses, longevity;
- Self-declared, subjective health;
- Personality;
- Environment;
- Financial situation;
- Self-declared aging well.

The study by Depp and Jeste reveals that the two criteria the most often cited by those interviewed are handicaps and problems resulting from reduced cognitive capacities. It is necessary to take into account the objective aspects (physical health problems) as well as the subjective aspects of aging well in order to fully understand this concept.

2. Aging and Savings

2.1 Savings in Economic Theory

The analyses by Keynes on consumption and income, by Irving-Fisher on inter-temporal choice, by F. Modigliani on the life cycle hypothesis, and finally the permanent revenue hypothesis constitute the major starting points in the literature. Keynes' absolute revenue consumption theory claims that individuals increase their consumption as their revenue increases, but proportionally less than the increase of revenue itself. Duesenberry claims that the level of consumption depends not on the individual's absolute revenue level but on the relative level compared to other individuals, i.e. relative revenue theory. Fisher's works constitute a turning point with respect to the Keynesian theory of current income. He introduces the temporal dimension into consumption and shows that individuals are rational in their present and future consumption choices in order to maximize satisfaction throughout their lifetimes. Consumption is thus a function of income over the lifetime of an individual.

This result is also shared by Modigliani and Friedman. Modigliani, in his life cycle hypothesis, links consumption to anticipated income during the life cycle, which is the course of a life. According to Modigliani, the individual seeks to smooth out their consumption over the entire life cycle. Friedman, with his permanent income hypothesis (anticipated average long-term income), supports that this permanent income is central to the consumption decisions of the individual. Considering the temporal dimension of income has been shown to be important in discussing savings and its link to the demographic transition. In this sense, Modigliani's studies have highlighted the importance of age in individuals' savings composition. The first developments of life cycle theory appeared in Modigliani and Brumberg (1954) and Modigliani and Brumberg (1980). The key hypothesis of these two works is to suppose that an increase in resources over the life cycle of an individual brings a proportional increase in consumption in each period of that lifetime. Modigliani and Brumberg (1954) confirm, above all, the already-known result of gradual savings growth with increasing income at both a microeconomic and a cross-sectional level. Modigliani and Brumberg (1980) hold on to the microeconomic and temporal series implications of the different aggregates, like consumption, income, income expectation, active population, and the demographic structure of the population. It is finally with Ando and Modigliani (1963) that the life cycle theory is developed as it is known today.

2.2 Demographic Transition Through the Lens of the Life Cycle Theory

How do consumption and savings choices change according to age? There is an age for saving and an age for consuming those savings. Working people save during certain periods and consume during others. The hypotheses underlying the basic version of this theory are the following:

- Income is constant throughout the period and zero at retirement;
- Interest rate is zero;
- The preference function implies a constant rate of consumption throughout the life cycle;
- Heritage is absent.

During the periods of youth and retirement, therefore, the individual has a higher consumption level than income level and, consequently, engages in dissaving. During working life, however, the income level is superior to the consumption level, allowing for savings. Modigliani derived several implications from this on a microeconomic level:

- The savings rate of the country is entirely dependent on income per capita;
- Divergences between national savings rates do not result only from divergences between citizens' savings propensity, even with identical individual behaviors;
- Individual behavior being identical, the global savings rate will be even higher than long-term economic growth, and zero for zero growth;
- The wealth/income ratio is a decreasing function of the growth rate, and attains its maximum at zero growth;
- An economy is capable of accumulating significant wealth with respect to income, even in the absence of bequeathed wealth;
- Length of retirement is the principal parameter that controls the wealth/income ratio and the savings rate for a given growth rate.

These results have opened the way to many discussions, for example on the issue of the population's demographic structure and its influence on the country's savings rate. In light of the life cycle theory, it follows that the increase of the savings-age population (working population) relative to the dissavings-age population (adolescents and retirees) allows for an increase in the savings rate of a nation: there exists a negative, inverse relationship between the

dependency ratio (relationship of adolescents and retirees to working people) and aggregate savings.

Validation of the life cycle theory is far from unanimous, however. Baranzini (2005) raises four questions that explain the criticisms of this theory. First, there exists a significant intergenerational transmission of wealth, with motives that are exogenous to the life cycle model. Next, the savings rate of the rich is always more dynamic than that of the poor, as suggested by Keynes. Additionally, stylized facts show that, especially in Western Europe and Japan, young workers save a positive and growing part of their income, in total contradiction with the theory. Finally, empirical studies find that retirees put aside a significant proportion of their pension, which supports the first statement. Many studies have been conducted to verify this theory. As the dependency ratio grows, a reduction in the savings level should be expected. On a global level, the major constant is that industrialized societies are confronted with an increasingly aging population, whereas developing countries are at a weak level of demographic transition, with a fast-growing working population and a shrinking ratio of young dependents. This difference in the demographic evolution between the two types of regions prompts some analysts to consider that the older population's consumption needs will induce a drop in savings in industrialized countries, and will create a lack of available capital when developed economies will need it for their investments (OECD, 1996; McKinsey Global Institute, 1994, 2004).

Others, on the contrary, maintain that this demographic transition will lead to a reduction in investment needs in industrialized countries, creating a savings surplus and an economic stagnation (Cutler et. al., 1990). The famous Feldstien-Horioka puzzle must be mentioned here. Feldstein and Horioka (1980) cross-analyzed the optimal savings rate of a country, the tax change incidence, and the international market functioning of capital. These studies asked questions regarding the international mobility of the worldwide capital offering and capital movements in order to equalize performance between countries and the nationalization of savings. The result, unsurprisingly, is that the domestic savings rate and domestic investment rate are strongly correlated, which contradicts classical economic theory (with perfect capital mobility, savings should be invested where performance is high).

3. Aging, Income, and Technology

3.1 Reasons for Retirement

The literature on retirement comprises studies that have followed two approaches: the rational choice theory and the *push and pull* factors. The first approach is based on the classical theory of rational choice and regards the decision to retire as a choice based on usefulness. The second predicts that the retirement age is determined by incentives that encourage leaving work and individual characteristics that encourage working people to take their retirement. These determining factors can be more generally classified in two categories: economic or monetary determining factors and non-economic determining factors.

In the first category, the choice to retire is modeled on the arbitration between income and leisure. It is considered that the individual chooses to retire at an age where future income loss balances the gain obtained in terms of leisure or inactivity (Blanchet and Debrand 2007, p.40). The factors that come up in this schema are varied, including personal rights to retirement, direct or derived spousal rights, taxation, the possibility to accumulate employment and retirement, and available heritage. Another possible motivation is professional reinsertion difficulties resulting in a weak demand for workers between the ages of 50 and 64 years.

In the second category, there are multiple factors. First of all, there are individual determining factors. Health, for example, has been demonstrated to be very important and plays a double role: poor working conditions can endanger the health of aging workers and poor health can determine an early retirement. Life expectancy is also a distinguishing individual factor because it implies for older people “a wealth effect at the end of their life cycle, an uncertainty effect on their savings, an effect linked to the risk of longevity,” (Debrand and Sirven, 2011, p.3). There are also contextual factors, like the family and professional environment. More precisely, the choice to retire is influenced by the spouse: there is a positive relationship between an individual’s decision to retire and that of their spouse; on the contrary, the relationship becomes negative between the choice to retire and the spouse’s health. As for the professional context, work satisfaction is as important: many studies show that a lack of workplace fulfillment generates cognitive decline and impacts the willingness to cease professional activity beforehand (Fleischmann et. al., 2014).

The relative weight of these determining factors changes from country to country and adds to the legislative constraints particular to each nation. In the European Union, according to the results of the SHARE 2004–2006 study, the factors that count the most in the individual

sphere are age, health, education level, and family size. The empirical analysis by Fleischmann et. al. (2014) shows that in 21 countries there is a positive relationship between retirement age and work quality, as well as between health and working conditions.

As for the contextual category, the main motivations arise from working and spousal conditions. Finally, the institutional context, in particular the social protection system, is significant in this choice (Debrand et. al., 2009, p.49). As far as this issue is concerned, the French system does not encourage early retirement. An early retirement with full pension carries penalties in the form of additional contributions and a reduction in pension payment years (Hairault et. al., 2008).

In general, it is rather rare that workers go from full-time to a totally inactive situation. The transition to retirement often includes three intermediary paths: unemployment, medical insurance or disability, and early retirement programs (Fleischmann et. al., 2014, p.3). The first path consists of requiring the employee to go through a period of unemployment before benefiting from retirement; the second applies to those having real health problems, but can also apply to those having trouble adapting to a position following a change in required skills; the third (which has been widely used in France) concerns programs created for particular sectors and widened to include specific businesses, or generalized on a national level following government intervention (Börsch-Supan et. al., 2005, p.246–252).

The 2004 SHARE study enumerated the differences in terms of retirement transition between 21 European countries. The countries where the path of forced unemployment is frequently used are Germany, Austria, and France, although they are applied at different ages. The Netherlands mostly uses the disability path: 15% of people between the ages of 60–64 years declare themselves disabled with respect to work, compared to only 2% over the age of 65 years, the legal retirement age in that country. The Southern European countries, Italy, Spain, and Greece, do not use a preferential course, but the transition between work and retirement concerns men in particular because women are often already at home. Finally, Switzerland has the highest retirement age, but the declared disability and unemployment rate for the over 60s is under 2% (Börsch-Supan et. al., 2005, p.246–252).

3.2 Inequalities between Age Groups and Intergenerational Transfers

The demographic transition provided a change in relationships between generations (André Masson cited in Onvalet, 2010).

Louis Chauvel (1998, 2006) talks about the demographic transition in terms of social elevator breakdown. According to the sociologist, we are witnessing an increase in intergenerational inequalities that, together with mixed economic growth, has created a social elevator breakdown to the disadvantage of the younger generations. This impasse manifests itself through the “calling into question of their relative economic position, the more frequent social downgrades, a marginalized political access” (Chauvel, 2006, p.1) and seems to have long-term characteristics.

D’Albis and Navaux (2014) analyze the intergenerational inequalities in France while adopting an international comparison. Concerning income inequalities, the situation for French youth is more deteriorated with respect to the baby boomer generation, which has enjoyed better conditions on the employment market. This can be seen by comparing the “standardized average income for those between the ages of 45–59 years with that of those between the ages of 35–49 years, which has passed from 0.81 in 1981 to 0.94 in 2009” (D’Albis, 2014, p.6). In addition, the peak of the working income distribution has greatly evolved, represented by an age of 39 years in 1974 and 49 years in 2009. On the contrary, studying the distribution of total consumption shows that it does not change as a function of age and is getting closer to that of Central European countries. Even without strong consumption inequalities, in France as in Japan, there is a certain favoritism for the 60–74 years old category, i.e., seniors and those not working.

The increase in life expectancy explains in part this redistribution in favor of older people. Since the 1970s, a shortening in productive periods (where the individual is net contributor), due to an increase in the entry age to working life and an extension in lifetime, with the consequence that the individual consumes more than they produce, has been witnessed. There is therefore a division of income, and consequently a consumption in favor of the baby boomer generation (D’Albis, 2014, p.69–70).

3.2.1 Intergenerational Transfers in France

Intergenerational transfers “are resource or heritage fluxes that circulate between the generations” received from the family, the state, or the market. They are composed of income redistributed through taxes, contributions, or savings that benefit a certain generation. In order to calculate these fluxes, the national transfer accounts method is used, which is structured around the idea of the economic life cycle, i.e., by analyzing total consumption and work income by age (D’Albis, 2014, p.64–65).

D’Albis (2013) shows that in France, transfers between 1979 and 2005 guaranteed a good level of equality between generations. Other studies, however, reveal that recent changes in these transfers are no longer balanced. Lorenzi et. al. (2012, p.4) analyze these transfers by dividing them into three main categories: government—family transfers, intrafamilial transfers, and business—family transfers. The first are the most important in terms of GDP (38.71% in 2009) and are made up of all social and education expenses. Looking at sharing between different age categories, it is of note that these transfers were at 10.07% for young people between 0 and 24 years old, 9.7% for the 25–60 category and 18.94% for the over 60s. In second place are the interfamily transfers, which favor young people more via inheritance and informal aid. The 0-24-year category was paid up to 1.46% of the GDP, and the 25–60 year group was paid 2.47%. On the other hand, transfers to the elderly were negative (—3.22%). In last place are the business-family transfers, i.e., all the health or education paid to employees, which represents only 1% of the GDP for workers and 0.2% for the under 25s.

In total, the intergenerational transfers were rather unbalanced in favor of older people, who received 15.72% of the total transfers. This percentage has increased in recent decades, in particular for those concerned with “retirement, health, and dependency transfers” (Masson and Arrondel, 2012, p.6), and could cause problems in the future (D’Albis et. al. 2013; D’Albis and Navaux, 2014).

3.2.2 Intergenerational Transfers in Europe

The SHARE survey also counts the intergenerational family transfers in Europe, excluding property transfers, concentrating on “scheduled and limited aids” of money and time (Wolff and Attias-Donfut, 2007, p.118). The results show that these transfers are mainly of a descending character, since 66.4% are directed to children and 13.9% to grandchildren. More precisely, grandparents provide financial aid after the age of 75 in the form of time transfer as

caretakers of their grandchildren (Attias-Donfut and Ogg, 2009, p.18). Next, there are significant differences between governments. Switzerland has the highest rate, with an average transfer of approximately €9000, followed by France (€5000 on average) and Denmark (around €4000). Below the average are Sweden (less than €2210), Greece (€3040), and Italy (€3320).

Two theoretical models have been developed to explain financial transfers: altruism and exchange. The first is based on the observation that transfers are made for the well-being of the receiver, with no compensation; the second, on the contrary, is based on payment of services or time rendered. The results of this study present two motivations as explanations for transfers from parents to children in Europe (Börsch-Supan et. al., 2005, p.182).

On the other hand, upward transfers, in particular to parents from children, are much greater in the Mediterranean countries Italy and Spain, while they are rarer in Nordic countries or Central Europe. This disparity is explained by the difference between the retirement systems, which are much weaker in the southern European countries, and where the non-working need family transfers (Börsch-Supan et. al., 2005, p.180).

Using these same data via a *probit* model, Wolff and Attias-Donfut (2007) estimate the probability of transfer diffusion. The probability for received money is extremely high in Greece, followed by Italy and Sweden. It is, on the contrary, very low in Spain, the Netherlands and Denmark (Hollanders, 2015).

The results of the first wave of the 2004 SHARE study repeat themselves in the second 2006–2007 wave with respect to financial transfers. The results by country “are comparable from one era to the next; as for individual practices, they change noticeably. Only a minority of people exhibit a continuity through time in the majority of aid given or received” (Attias-Donfut and Ogg, 2009, p.21).

3.2.3 Intergenerational Transfers Worldwide

The creation of the National Transfers Accounts methodology has made it possible to measure intergenerational transfers in many of the world’s countries, thanks to the adoption of a common generational accounting method².

One interesting case to examine is that of South Korea. Government transfers are at 27% of all transfers to children, lower than the average in developed countries. On the other hand, public transfers to older persons are more significant and account for 37% of the total. Looking

² INED, available at <http://ctn.site.ined.fr/>

at the structure by population age, it can be seen that the under 20s and the over 65s consume more than they produce, depending on transfers and asset-based reallocations. In detail, the under 20s depend 73% on private transfers, whereas for seniors the percentage is closer to 53% (Lee and Mason, 2011, p.381–387).

Two other Asian countries are interesting to analyze: China and India.

China has experienced a significant change in government transfers between 1995 and 2002: while in the beginning the state provided very few services, as of the 2000s it had increased its spending. Future radical improvements are expected, particularly in health and education. With regard to older people, however, they are still largely dependent on children, receiving financial support of up to 30% and 50% (Lee and Mason, 2011, p.408–418).

India has a high number of private transfers to younger people, who are 6.9% more dependent than seniors. Intrafamily transfers count for 51% of the youth deficit, whereas transfers to seniors are largely less generous. The lack of government transfers makes family aid indispensable to the survival of the more dependent groups of the population (Lee and Mason, 2011, p.459–470).

In Brazil, the intergenerational transfer situation is remarkable because the country presents a significant public sector as well as a quickly aging population. In this context, older people receive a level of government transfers greatly superior to the youngest part of the population, i.e. seven times more than in the USA and between 4.5 and 7.5 more than in European countries. They finance senior consumption in all socioeconomic settings. At the other hand, private transfers are for the most part directed to children. The sum of these transfers, however, is particularly unequal if the differences in social classes and territorial disparities found in Brazil are taken into consideration (Lee and Mason, 2011, p.394–404).

Uruguay's case is different than that of Brazil. Government transfers carry a financial reallocation of the middle-aged towards older people and children. Seniors, however, contribute with private intra- and interfamilial transfers to support young people. For seniors, 76% of government transfers are made up of pensions, whereas for children, the biggest component is educational spending (Lee and Mason, 2011, p.434–444).

Finally, an analysis of Nigeria reveals that public transfers are mostly made in favor of younger people, in the form of health and educational services, whereas transfers to older age groups are lacking. For seniors, this signifies the necessity of family funds and asset-based reallocations, making them very dependent on the family (Lee and Mason, 2011, p.446–456).

3.3 Demographic Transition and Innovations

3.3.1 The Silver Economy

Population aging, beyond being a demographic question, embodies veritable economic stakes. Increases in the aging population in developed economies cause difficulties at the level of public spending balance and job market evolution. The European Commission predicts that spending linked to aging in the European Union (EU) will represent 30% of the GDP in 45 years. Similarly in France, DREES projections predict that spending linked to dependency will increase by 80%, reaching 35 billion in public spending in 2060.

One possible response to this change resides in the Silver Economy, “a set of economic and industrial activities that benefits seniors, defined as people over 60 years old” (Villemeur, 2014, p.3). Merrill Lynch estimates the value of the Silver Economy worldwide at \$7000 billion (European Commission, 2015). Investments in this type of activity can represent a source of financing in order to balance state accounts.

In detail, the Silver Economy consists in economic activities that aims to adapt production and distribution systems of goods and services for the well-being of older people and future seniors (Laperche and Uzundis, 2014, p.1; Klimczuk, 2012, p.52). It is not characterized by a pre-defined sector, but rather is situated at the intersection of different fields. More precisely, the Silver Economy concerns 14 particular segments: “computing applications in hospital care and mobility; housing and community life services adaptation (automation and robotics); promoting independence; health economy, including medical assistance and e-health; education and culture; media [...]; service robotics, in particular in combination with independence development; mobility, e.g. intelligent automobiles and road safety; leisure, travel, communication, and entertainment; physical and well-being activities; clothing and fashion for better social integration; personal services; insurance (social security), in particular with respect to age-specific risks; financial services “sensitive to the demographic,” in particular in the area of capital protection, heritage guarantee or transfer, etc.” (Boutillier et. al., 2015, p.14).

This new economy, however, has strong potential and poses a real challenge. On the one hand, it must respond to the growing demand of seniors in terms of personalized health services as well as technological innovative products. On the other, it must guarantee a way of life that is satisfying for older people, so that they continue to work efficiently and maintain good health, thus weighing less on the social protection budget (Ahtonen, 2012, p.1). It has

been demonstrated that the technologies applied to the Silver Economy allow seniors to remain in the work force longer, because they can replace a certain number of human activities that are difficult for the oldest group (Klimczuk, 2012, p.52).

In France, the Silver Economy was officially recognized in December 2013 with a sector contract including eleven key fields: habitat, communication, transportation, e-autonomy, security, health, services, distribution, leisure, work, and tourism. In this country, however, the development of this market is yet to be seen. The list of services to be provided for aging well is long: health-related services, with care-practices training for nurses's aides or families or the establishment of remote medical consultations; professional care and administrative services; social services, especially for the use of new technologies in computers and communication; in-home help and residence adaptation services according to seniors' needs (Apouey, 2015, p.5–9). The lack of an adequate offer means that the Silver Economy remains a niche market trying to fully institute itself.

3.3.2 New Technologies Serving the Demographic Transition

The aging of the population also impacts technological innovation: new technologies are developed to respond to seniors' needs through the Silver Economy. In this case, this refers to gerontechnologies, i.e. “new technologies, founded on intensive use of the ICT (Information and Communications Technologies)”, whose goal is to act in favor of aging well and who, in exchange, “can allow for the realization of productivity gains not only in the sectors they use, but also in the industries that produce them” (Boutillier et. al., 2015).

The main field of action is the IOT (Internet of Things), which develops increasingly targeted technologies. The number of connected devices could attain 50 or 80 billion units in the world within the next five years. The connected devices find a central field of application in the sectors linked to well-being and aging, particularly in France. However, if many SMEs are dedicated to this sector, the utilization platforms—necessary to the usage of these connected devices—are dominated by big digital multinationals, like Google and Facebook, which implies a veritable problem for future expansion of the sector.

Robotics also represents a sizable technological tool; robots can provide services and assistance to older people who are not independent. The range of robots is ample and differentiated, from AIBO, the robotic pet dog, to KOMPAI, the robot created especially for seniors with cognitive problems, helping them accomplish daily tasks. Elsewhere, there is

strong development in the nanosciences, which include in part the nanotechnologies, biotechnologies, artificial intelligence, and cognitive services (NBIC). These target not only quality of life and longevity improvement, but also promise to represent a third industrial revolution, to be able to manipulate “matter for human ends.” (Boutillier et. al., 2015, p.18)

Other than specific technologies, the Silver Economy is characterized by *geront’innovations* (Laperche, Uzudinid, Clerse in Boutillier et. al., 2015, p.12), even material or immaterial innovations in favor of older people in difficulty, complementing gerontechnologies and helping them to develop. They are mainly created for seniors described as “weak”, with “functional disabilities and an eventual decrease in their capacity to adapt or to anticipate,” or “dependent”, defined as “persons in need of assistance to accomplish essential and daily actions or who require regular surveillance” (Ingham in Boutillier et. al., 2015, p.28). Furthermore, these innovations should respond to corresponding and multiple challenges: “acceptation, inclusion, and adaptability,” in order to treat problems connected to holistic aging.

3.3.3 Policies to Support These Innovations

Public authorities play a key role in Silver Economy development. Globally speaking, issues relative to healthy aging have been taken into account by several international organizations. The United Nations began focusing on aging issues in 1982 with the *Vienna International Plan of Action on Ageing*. The 62-point document encourages tangible actions in terms of health, employment for seniors, and protection of the elderly. In 1991, the General Assembly adopted the 18 *United Nations Principles for Older Persons*, with, in 1992, a *Proclamation on Aging*. After declaring 1999 as the International Year of Older Persons, the General Assembly gave a second World Conference on aging. This meeting triggered the *Political Declaration and the Madrid International Plan of Action on Ageing*, a document for governments with recommendations about policies in favor of senior citizens and the demographic transition.

In 2016, the World Health Organization (WHO) gave an international conference on the following theme: “Multisectoral action for a life course approach to healthy ageing: global strategy and plan of action on ageing and health,” followed by a resolution adopted in May 2016 anticipating a plan of action to develop healthy aging in all Member States. The strategy has two objectives: a 5-year action plan to help older people improve their functional capacities, and the organization of a 10-year support team for “Healthy Aging” from 2020 to 2030. This policy has five strategic objectives: commit each State to encourage healthy aging, develop age-

friendly environments, adapt health systems to elderly demands, develop tenable and equitable systems for long-term medical treatments, improve healthy aging standards, monitoring, and research.

A major incentive in Europe was conducted by two international organizations: The United Nations Economic Commission for Europe (UNECE) and the Organization for Economic Cooperation and Development (OECD). They encouraged European countries to invest in R&D in both medical and healthy-aging sectors as an instrument to avoid negative effects from the demographic transition, government expenses in particular (OECD, 2012). The European Commission expressed themselves on the subject by underlining the need for Member States from the European Union (EU) to create reforms for the Silver Economy (European Commission, 2015). With this in mind, targeted actions were launched:

- The European initiative for age-friendly housing, inaugurated in March 2016, supports policies to adapt housing for seniors. The initiative was triggered by the following assessment: 75% of European housing is not adapted to older people. These elders cannot afford the renovations themselves, and subsequently become less independent with a growing need for medical assistance. Investment in “age-friendly” solutions therefore contribute to a decrease in public health care expenses for the elderly.
- The objective for The European Innovation Partnership on Active and Healthy Ageing (EIP-AHA) program is to unite principle actors of the sector and to support appropriate practices in terms of the aging economy to trigger a regional growth strategy.
- The launch of the *Digital Innovation Plan for an Ageing European Population in the 21st Century* has the objective of creating an ecosystem to foster digital innovation and promoting access to financial resources and structural funds for the Silver Economy society.

Measures taken for the Silver economy on a national scale can be divided into three categories: strategic programs, research and development institutions, and network organizations and clusters (Klimczuk, 2012, p.53–55; Boutillier et. al., 2015, p.28).

The United States was the first country to react in terms of strategic programs with, in 1974, the National Institute on Aging, a government institute dedicated to research on healthy aging with information for the general public and collaborations with outside entities. Research covers areas such as Alzheimer’s, quality of living, medical treatment access disparities, and developing adapted infrastructures. In 2009, the government published a roadmap in order to develop the health care robot industry to assist the elderly. The United States has a great advantage in the NBIC sector as it is widely developed in the country and they are consequently the world leaders.

As part of the 2004–2012 framework program on research and innovation, the European Union launched the European Research Area in Ageing consortium to unite and coordinate the work of thirteen research centers specialized in the area. The consortium is also responsible for stimulating research on aging by, for example, funding scholarships, summer schools, and facilitating cooperation with national governments. The consortium was renewed for a 2012–2020 program and completed by the Ambient Assisted Living Joint Programme, managed by an association of scientific agencies from 20 States in the EU plus Israel, Switzerland and Norway. The organization has the objective to fund the private sector and facilitate collaboration among SMEs, consumer associations, and university centers.

Japan encountered the demographic transition earlier than other countries and therefore became proficient in robotic gerontechnology. In 2001, they created the 21st Century Robot Challenge with special focus on domestic robots. In 2006, the government published a report called *Challenges for Building a Future Society—the Role of Science and Technology in an Aging Society with Fewer Children*, which underlines the efforts needed for the demographic transition and stresses the need to orient research on health economy and healthy aging technologies.

China has also invested in applied aging research: scientific articles about NBICs have increased in recent years, more than in the USA. They are also progressing in IOT technology. An example of this is the city of Wuxi, converted into a specialized district in the sector with 1000 companies and a \$10 billion turnover. The government has indicated this industry among the seven strategic sectors to be developed in the 2011–2012 Industrial Development Plan.

In France, *l'Agence Nationale de la Recherche* (National Agency for Research) financed many specific projects, “like the Quo VADIS Program (2008–2010), designed to develop systems associating technologies and services in housing for the disabled, the elderly, and for cognitively deficient persons” (Boutillier et. al., 2015). The government also launched the France Robots Initiatives Plan in 2013 to develop a National Fund to support SMEs specializing in robotics with sector-based “Robolution Capital” funds launched by the Orkos Capital risk fund and supported by the *Caisse des Dépôts* (Deposits Fund). Several government-owned geriatric centers were subsequently established in several French cities to create a direct link between SMEs and research centers. IOT development was identified as a priority in the 2013 Industrial Plan by the Ministry for Industrial Recovery with practical measures such as a connected neighborhood in Angers.

A cluster of innovations and networks was also created. Germany, for example, with the SEN@ER—Silver Economy Network of European Regions, established to foster an environment conducive to creating new products and direct services for seniors. Similar clusters were opened in Europe (EDEAN—European Design for All e-Accessibility network), in the United States (CAST—Leadingage Center for Aging Services Technologies), in Japan (RooBo), in France (SilverValley) and in Finland (prosperity clusters and Seniorpolis).

To conclude, many gerontechnology research centers have opened. The Setha team was created in Berlin, Germany in 1997 by six university colleagues from different backgrounds, The Center for Research and Education on Aging and Technology in the U.S. focuses on information technology, and MIT's AgeLab is dedicated to new technologies applied to many sectors. France also has several laboratories and research centers working on healthy aging technologies such as the *Centre d'expertise national en robotique (CenRob)* (National Centre for Robotic Expertise), which opened in 2010.

4. Aging, Growth, and Employment

4.1 Impact of the Demographic Transition on Growth

4.1.1 Theoretical Framework

Economists have wondered over the demographic transition for many years, especially the influence it has on population development during economic growth. Connecting factors between these phenomena are multiple: a request for goods and services, savings evolution and job market variations. Economic literature on the demographic growth effect is quite diversified. Three of thought can be found on the subject: pessimistic, optimistic, and neutral.

The first movement was led by Thomas Malthus, who, as early as 1790 predicted that an uncontrolled population increase would seriously exceed farming production capacity in a world of limited resources. (Bloom et. al., 2001, p.9). His theory was reconsidered by the neo-Malthusian orthodoxy between the 1960s and 70s, expanding on the idea that a high population growth was a source of danger for low-income countries, thus authorizing birth control policies (Blanchet, 2001, p.525). The hypothesis for this reasoning is: “there exists a phenomenon of falling revenues according to the population mass at a given technological level” (Blanchet, 1989, p.615). By considering exogenous technical progress, demographic growth is not revealed as a source of economic growth. The Malthusian hypothesis is used as a model throughout the Solow model, a neoclassical model of exogenous growth that can be used to control links between demography and growth. His theory is based on the hypothesis that there are two production sources, capital and work, and they determine production growth (extensive development), thanks to an increase in quantity or improvement of productivity (intensive development), introduced by exogenous technical progress. An increase in the working population would therefore indicate a higher level of production since work availability would also be on the increase. “However, because it induces capital reduction, it can be seen as a lesser intensive growth. The solution therefore, is to increase savings, in other words, by sacrificing today’s consumption we will increase consumption for the future.”³ Demographic variation weighs on factors of compensation: the capital will become increasingly rare and work, on the contrary, will become the most abundant factor with a reduction of product per head, thus leading to a reduction in wage under the hypothesis constant returns to scale (Aglietta, Blanchet

³ Amson, A. *Démographie et Croissance*. Melchior, science and economics internet site. <http://www.melchior.fr/etude-de-cas/demographie-et-croissance>

and Héran, 2002, p. 93–94). This growth therefore has a negative effect on standard of living, but the negative effect due to slowdown is even greater since it induces a decrease equivalent to the return of capital (ROC), which cannot be remedied by technical progress. Overall, hyper-acceleration and deceleration of the population have negative effects on macroeconomic variables: “a very rapid decrease, due to its effects on the dependency ratio for older people, and in cases of rapid growth, which would cumulate dependents due to high a ratio of young dependents, and other effects linked to significant decreases in savings” (Aglietta et. al., 2002, p.97).

However, successive studies reveal that, like the Malthusian trap, this can be avoided by underlining the importance of other factors such as technology and the accumulation of human capital (Bloom et. al., 2001, p.9). Technological progress and revenue increases, despite world population doubling in size, have created the foundation for this new, theoretical framework.

The Malthus theory was criticized by Alfred Sauvy in his *Théorie générale de la population (General Population Theory)*, illustrating a positive relationship between demographic and economic growth.

And a new, optimistic theory emerged in the 1980s to replace the precedent. Julien Simon, for example, theoretically demonstrates the positive link between population growth and economic growth due to technological progress—the price for natural resources has a tendency to long-term drop and progress is triggered by a demand increase from the growing population. Another theorist supporting this positive link, Ester Borup, believes that demographic growth is a source for innovation through what he describes as “creative pressure” (Solignac, 2010, p.69). Borup’s vision was later further developed by other studies (Darity, 1980, Pryor and Maurer, 1981). This research confirms that population variations trigger new technological creations and consequently, growth. Other works based on this theory have widened the scope of research in this field. These studies prove that countries with dynamic demography have more potential for developing new technology (Beaudry and Green, 2000) and that increase in workforce leads to improved research and innovation levels (Phelps, 1966) and learning levels (Arrow, 1962).

Furthermore and according to Romer, “there is a positive population scale effect on the growth rate which is even more significant when human stock capital is greater” (Lemoine 2013, p.15). This optimistic tendency does not exclude other positive or negative

factors with an effect on the demographic evolution. For this reason, a new group of concepts termed “neutral” has a key role on the stage for economic debates.

This thought movement is based on the works of Adam Smith, who explains the wealth of nations through labor division. Economists were more interested in analyzing his theory, supported by the fact that many empirical studies found the correlation between demographic and economic growth of little significance. The neutral trend has become today’s major theoretic framework (Bloom and Williamson, 1997, p.11–12).

These studies, however, overlooked a very important characteristic for evaluating the impact of demographic changes: population structure by age. It has gone through significant changes in both developed countries and on emerging markets due to an aging population. Two systems can be used to present the phenomenon: “aging at the top” characterized by the 60 plus age category versus total population; or “aging at the bottom,” a decrease in newborns revealing a reduction of this age segment versus total population (Solignac, 2010, p.66). All countries have been affected by “aging at the top,” but some, like the United States and France have not experienced “aging at the bottom.” “The most advanced countries in demographic aging are those that combine the two methods (like Japan and Germany)” (Ragot 2013, p.13).

Ricardo’s 1817 publication, *On the Principles of Political Economy and Taxation*, was the first to treat aging by identifying population development as an important factor for economic adjustment. An increase in labor leads to a decrease in wage, this reduction leads to a birth decline, which eventually in turn leads to a declining workforce. On the long term, this mechanism allows for recovering an economic and demographic balance (Solignac 2010, p.66).

Population distribution must be analyzed since consumption behavior and savings change for each age group and the revenue and consumption life cycle curve varies according to different impacts on the economy. “When the relative size of each of these groups in a given population changes, the relative intensity of these economic behaviorism also changes” (Bloom et. al., 2001, p.14).

Lee and Mason (2014) maintain that this demographic transition has positive and negative effects, called “the first demographic dividend” in developing countries: a decline in the birth rate with consequently less children and a relative increase in the working population proved beneficial for economic growth. Yet in developed countries, “a decline in fertility combined with increased life expectancy leads to an aging population and to fewer workers: the end of the first demographic dividend” (Lee and Mason, 2014).

4.1.2 Empirical Models

Theoretical models do not give a defined response concerning the relationship between growth and demography. For this reason, several empirical studies have attempted to verify the connection by analyzing data in various countries.

Until the 1980s, studies focused on developing countries in an attempt to measure the relationship between demographic growth and standard of living through GDP increase. Results for the majority of these transversal tests demonstrate that there is no negative relationship between the analyzed variables, yet they present interpretational problems because of an absence of correlation or a weak level thereof (Aglietta et. al., 2002, p.107).

Successive studies are more advanced and, on the contrary, focus on a strong link among the variables. The analysis by Cutler et. al. (1990), based on American data, demonstrates that population aging is positive on a short- to medium-term basis, yet negative on a long-term basis: it stimulates an increase in revenue for the next 20 years, but reduces GDP per capita by 5 points in 60 years. Furthermore, reduction of the standard of living can only be compensated by an annual productivity growth of 0.15% through a major capital intensity in production.

Mankiw et. al. (1992) developed a study to rehabilitate the Solow model to determine growth effects. By employing a *cross-country* style of analysis, they have demonstrated the exactitude of the exogenous growth model, in particular, the link predicted between population growth and revenue. However, in terms of magnitude, they realize that the model is not precise since they overestimated the savings effect and population change, a problem that could be solved by including, among the variables, the accumulation of human capital. The model is thus able to account for 80% revenue variations among countries.

Brander and Dowrick (1993), by using a panel of 107 countries on a 25-year time span (1960-85) demonstrate that an overly high birth rate has a negative impact on economic growth because of investments and dilution of capital. However, they also prove that a decline in the rate causes a reduction in revenue growth followed by an increase in employment offers and the dependency rate.

More thorough studies at a theoretical level unite the neoclassical models with a measure of intergenerational transfers. Lee and Mason (2014) use this methodology, applying it to 40 countries with various economic levels. They determined three ratios: the “Fiscal Support Ratio” (FSR), which represents influence from the population distribution by age on government expenses; the “Support Ratio” (SR), which resumes the effect of population distribution by age on revenue and expenses per individual including the public and private sector; the “Total Fertility Ratio” (TFR), which indicates the number of births per women of child-bearing age. The results are very different according to the category of countries studied:

in low-income countries the TFR is much higher (4.03) versus the ratio maximizing the FS (1.08) and the SR (1.75). On the contrary, in middle- and high-income countries, with the exception of Thailand and South Africa, the result is inferior, particularly for the latter. This signifies that countries with high revenues would benefit from a high birth rate.

Empirical results are very diversified too if regions are taken into account. In East Asia, a very high (5.8) to a very low (2.1) birth rate signifies an economic miracle from 1965–1990, with GDP growth rates at up to 6% per capita. This was possible since the working population's growth rate was four times greater than the dependent population's. This change was supported politically, economically, and socially and was accompanied by a production capacity increase per capita, giving these economies benefits related to the demographic transition (Bloom and Williamson, 1997). It was particularly beneficial for the Tiger Cub Economies with revenue going from 38% to 86% per capita, the average rate for developed countries (Jackson et. al., 2011, p.17). Yet, this reduction isn't slowing down: the population growth rate is at a current 0.66% and, according to predictions it will drop to 0.2% before 2025. This dynamic is a big challenge for high-revenue countries in the region and, on a medium-term basis, will be for others too.

Japan, for example, has the highest life expectancy (83.6 years old) and elders represent 26% of the total population, the highest in the world. The country has benefited from this demographic transition for years, especially due to the government, innovation, and educating the working class. Yet today, the trajectory seems to be changing. The enormous age increase within the population will make the current dependency rate of 47% explode to 96% within the next 35 years. With fewer families available to care for their elders, the government will have to provide for this growing age segment. Tenability of the Japanese pension system, another major challenge, could represent a budget deficit of 20% of the GDP by 2030. Furthermore, the decrease in the working population will have negative consequences on the economy and development (Bloom et. al., 2001, p.29). Other singular examples come from South Korea and Singapore: both have adopted policies to increase birth rates at an attempt to reverse the demographic curve, and South Korea also established a pro-immigration policy (Jackson et. al., 2011, p.18).

China is a case of its own: a flourishing, fast-growing market, the most striking of all with a 2 to 18% growth rate per capita, but the 65-year old plus age bracket already represents 8% of the total population and will most likely double in 2030 and triple in 2050 (Bloom et. al., 2011). Rapid aging of the population is forcing the country to take measures now to limit the problem, even if the population's standard of living is catching up to developing countries.

Figures reveal this limit: expansion of the working population will be hit hard within the next 10 years by a 2.7% decrease.

South East Asia followed a similar route, with a more restrained rhythm. The population growth rate dropped between 1950 and 1990 and stabilized at a 2% average per year. The birth rate dropped, but only from 5% to 3%. They have only just recently started to register similar rates to East Asia's. Furthermore, the demographic dividend was less advantageous to these two regions because the expansion of the working population versus the dependent population developed at a slower rate than the other referenced regions (Bloom et. al., 2001, p.33–34). India is a singular case and the most populated country in the world after China. Population growth for elders appears more progressive in comparison to China. It is currently at 5 percentage points and should reach 8 in 2030 and 12 in 2050. Aging in India does not, therefore, represent a major problem, but the country is going through more critical challenges, such as education and an enormous degree of inequalities (Jackson et. al., 2011, p.21; Agarwal et. al., 2016).

Tendencies in Latin America are comparable to East Asia, without the flourishing economy. The birth rate dropped by 50% between 1975 and 2000. The GDP per capita rate during the same period was only 0.7%. This contradiction seems to come from the political environment, less stable than in other regions (Bloom and Williamson, 1997, p.38). This was not the case for Brazil: the demographic transition had a direct impact on economic growth of between 0.4 and 0.5 GDP points per year, a total growth of 15% from 1976 to 1996.

The Middle East and North Africa have recently entered the demographic transition phase: life expectancy has increased (65 years old), but the birth rate is still high. The region has been growing economically for the past twenty years, stimulated essentially by the working-age population. But without a birth rate reduction, the dependent population percentage will increase, with negative consequences on the economy (Bloom and Williamson, 1997, p.39–40).

Sub-Saharan Africa is the only subcontinent with a constant birth rate; it is now facing a very high population growth rate, 2.5 in 2014, the same rate registered by two other African regions in the 1960s (Lam, 2014). Overall, the region has not entered the first demographic dividend, but the dependency rate has increased in the last decades, compensated by the working-age segment, representing 60–70% of the total population.

In developed countries (OECD, North America, Europe and Western Europe), the demographic transition began towards the end of the 19th century. Between the end of the 19th and early 20th century, the working-age population growth contributed to economic growth.

This wave ended after WW2, when forecasts became less optimistic particularly because of the drop in birth rate, which hasn't ceased since. In 2000, seniors registered 19% and forecasts predict that they will increase to 33% by 2050. There are considerable risks for these countries and negative consequences on growth if necessary measures are not taken

4.2 The Labor Market, Productivity, Wages

4.2.1 Demographic Transitions and Employment

Demographic transition has a significant effect on the labor market, both on offer and demand side. The 1960s baby boom stimulated a consistent growth in job offers. Between 2002 and 2014, the 65–74 bracket was the most significant in terms of labor participation. But this phase is now coming to an end due to the “relatively flexible relationship between the demographic evolution of the working-age population and the actual labor force itself,” which is not sufficient to counteract the imbalance caused by the retirement of this generation. As for demand, the relationship is more complex and several theoretical models are attempting to study this link.

If we consider that aging of the population causes a drop in employment offers, three conceptual frameworks measure the impact on demand (Cadiou et. al., 2002, p.146–148). The first is the approach to balanced unemployment where unemployment is a result of imperfections on the job market. Consequently, a reduction in job offers reduces unemployment, but with a weak impact because *ex-post* the level of unemployment depends on institutional conditions.

The hysteresis model is the second framework and characterizes long-term, persistent unemployment: job market imperfections create asymmetric shocks, which affect the level of unemployment and the medium-term balance. In this context, the reduction of job offers could have various effects depending on the preceding economical evolutions, but generally, “in the case of hysteresis, the demographic reduction can, at most, stimulate progressive unemployment reduction” (Cadiou et. al., 2002, p.147).

The last model is based on the Phillips Curve: it creates an inverse relationship between inflation and unemployment. Long-term unemployment is determined by price and wage rigidity. In this case, the medium-term impact of population aging on unemployment depends on this rigidity. If wages are flexible, reduction of the active population only has an impact on unemployment because of labor regulation policies. If, on the contrary, they are rather rigid, demographic change can drive towards a medium-term reduction of unemployment.

These models do not take into account structure by age of population, which can markedly change the effects on unemployment. First and foremost, differences have been established between unemployment rates for young workers and adults since unemployment drops with age. Aging of the population should have a positive effect on medium-term

unemployment, but the empirical results demonstrate that this effect is very weak: in France, the demographic transition reduced unemployment by 0.3% between 1997 and 2010.

These differentials are nevertheless a reality and can be explained by several factors. Young generations suffer more from unemployment because they have to cope with mechanisms called “waiting-line models;” they are more vulnerable to shocks and are preferential victims for the high cost of work. Senior workers, however, once unemployed, aren’t as likely to come back onto the job market since they aren’t as flexible or mobile and they ask for very high wages versus the market. Another explanation (Pissarides, 1989) could derive from a huge “senior worker” influence on trade unions, protecting them from unemployment.

Demographic transition changes the stability of unemployment rates for different age populations with indirect effects. The size of the age groups is the first. In a neoclassical vision, an increase in the working population “reduces the ratio of capital to work, which increases interest rates, and reduces wages” (Cadiou et. al., 2002, p.150). Individuals could therefore be less motivated to find a job, which leads, in some cases, to an increase in unemployment. Empirical studies evaluated the baby boom impact equal to 2% of unemployment between 1960 and 2000.

Another indirect link is the absolute size of a population age segment and wages: if the size increases, wages drop in a context of constant returns to scale (CRS). However, with professional experience and by consequence age, the effect weakens. The same link can be found between relative wages and the relative size of the cohort. Studies demonstrate positive flexibility between these two variables equal to 2.9 and explain revenue inequalities among different countries (Macunovich, 1999; Higgins and Williamson, 1999). The relationship then derives specific cost adjustments that are linked to the job market and have a different impact on the various age categories. This is the case for the cost involved when dismissing senior workers in regard to the Deladande tax in France (Gautié, 2010, p.36). To conclude, the last link reflects on productivity. The three theoretical frameworks are as follows:

- 1- Equality between wage and productivity for all age cohorts. Increased unemployment or employment rate in a specific category can be explained by different adjustment costs;
- 2- Senior wages superior to their productivity level, derived for example, from institutional obligations such as the accumulation of human capital;
- 3- Senior wages that are superior to productivity to compensate the wage deficit for beginners. A recurrent case in large companies.

When analyzing wages for different age categories, the rule establishing that wages are linked to productivity, is not always true. In general, younger workers are paid less according to their level of productivity while the opposite is true for seniors. This phenomenon has a major risk: “a high wage increase, partially uncorrelated by a growth in productivity” with huge inflations as a consequence, or “the questioning of the link between the actual unit labor cost and the age of workers” (Cadiou et. al., 2002, p.151).

4.2.2 Aging and Productivity

If wages for seniors are higher, what can be said for their productivity? Research on this subject is vast and contradictory. We shall begin by comparing individual productivity to aggregate productivity.

In regard to individual productivity, we should keep in mind that over the last decades, developed countries have undergone an aging phenomenon, yet employees are getting younger (Pelletan and Villemeur, 2012, p.147). Thanks to better health conditions, life expectancy and healthy living are both possible and on an increase. As to productivity, neuroscientists have proved that as of 35 years old, there is a reduction of certain cognitive capacities linked to work. For example, visual perception and manual agility for the 55 to 65 age bracket significantly decline. Yet, these studies have their limits: they employ a transversal methodology that overestimates aging effects, and results show the disparities among age categories rather than the direct effects of aging. Moreover, this analysis is focused on aging consequences in general and not on aging consequences linked to work (Faurie et. al., 2008, p.155–156).

On the contrary, other capacities are stable, including those linked to accumulated human capital, managerial capacity, and experience (Levasseur, 2015a, p.346–347; Skirbekk, 2004). As a consequence, productivity is nonlinear: a peak at around 50 years old and, subsequently, a decline that varies according to profession, but superior to that of the 30 and under age bracket (Pelletan and Villemeur, 2012, p.151).

Human capital is central in the ‘age to productivity’ relationship for two key reasons (Pelletan and Villemeur, 2012, p.152–156): First of all, as people live longer, due to longer life expectancy, this increases their desire to get an education — since the 1970s, “individuals have dedicated [...] 45% of their savings in terms of life expectancy for a longer education” (Pelletan and Villemeur, 2012, p.152). The consequential increase in human capital has a positive impact on productivity with a progressive accumulation according to age. Investment policy impact is equally important. It is observed through two mechanisms on education and productivity

development: accumulation of the general capital, therefore a high level of education which leads to an increase in average productivity, and accumulation of specific capital with targeted continued education, which eliminates the less productive workers from the market. The second reason is in regard to health: recent studies establish a positive relationship between health and productivity due to a reduced mortality rate for employees aged 40 and under and improved health conditions throughout their active lives. Moreover, health affects the accumulation of human capital: the healthier the employee, the better their learning level.

Studies on productivity, in a broader sense, focus on company level, sector and the macroeconomic context (Levasseur, 2015b, p.353–357). In the first category, most of the studies measure total company productivity according to input from each age group. The results give an inverted U curve: productivity increases to a certain degree (50/55 years old), and subsequently drops. However, this model is a bit crooked, given the non-consideration for the number of hours worked and the method used. But more recent studies, by using different methodologies like longitudinal/panel data, reveal a weak or insignificant correlation (Vandenberghe, 2014, p.4). Research on this sector of activity is equally discordant according to the data used, which does not allow for a consensus. In the third case, productivity is measured on a macroeconomic level, therefore by country, for example, according to GDP per capita. The analyses do not agree on the type of relationship revealed: Feyrer (2007) finds a positive correlation between the 40 to 50-year old population growth and aggregate productivity, while Werding (2007) states that there is an inverted-U relationship between the structure of the population and the total productivity growth rate of the factors. Yet, these studies use aggregate data, which creates synthetic and not totally exploitable results, as they do not identify precise links between age and productivity.

4.2.3 Employment for Seniors and Related Education Issues

Employment for seniors is a key issue for countries with a low population growth and a high aging rate (Vandenberghe, 2014; Blanchet, 2006). In the European Union, the employment rate for seniors—people between the ages of 55 and 65, still in activity—was at an average of 51.8% in 2014, but with large national differences. In 2012, France registered a 40% rate, 8 points inferior to the average European rate, contrasting heavily with Northern European countries (at a 60% rate). Between 2000 and 2012, the level of employment in other European countries, such as Finland and Holland, was growing at 20–25% (Jolivet 2014). The delay essentially comes from a political decision supporting young generations and intermediate age

groups. Two measures have been employed to accelerate the departure to retirement for seniors: a younger than average retirement age, and preretirement (Hairault, 2012).

In face of challenges connected to the demographic transition, several measures have been adopted to take the presence of older workers into account. At an EU level, a European strategy for employment was staged in 1997 in favor of active aging. One of the pillars was to improve the senior activity rate, which has become the final objective of this communal action. But the European strategy did not have the impact hoped for as it was turned towards “‘convergence stress,’ in other words, merging pressure. It relies on a coordination method by objectives (‘open method of coordination’), which leaves the responsibility of acted policies entirely to Member States” (Jolivet, 2002, p.144), and it does not anticipate control at the top. Specific actions are then installed on a national level (Cornilleau et. al., 2008, p.140–148). First, fiscal incentives are implemented for companies that are employing or maintaining a specific level of senior employees. Denmark set an example of this in the 2000s. The country has been pursuing agreements between companies that employ older employees. The 2006 agreement on future prosperity, wellness, and future investments includes a number of subsidy measures for employment, initiatives to improve health and on-the-job conditions in specific sectors, and a 3 billion fund to finance specific projects. Other measures target seniors, for example, and since 1 January 2004, Dutch unemployment benefits have not exempted elders from the job hunt, offering tax credits to employers that increase according to the age of employee. In the United Kingdom, New Deal 50+ was a program that encouraged employment for age 50 plus, launched in year 2000. The program’s objective was to employ adult workers, and became mandatory in 2004 for the older category of unemployed people who “must choose between vocational training, a subsidized job, or an associative responsibility” (Cornilleau et. al., 2008, p.144). Other partnership programs with social parties and pension bodies were created in Finland to help keep seniors on-the-job. The National Program for Aging Workers, launched in 2005, was the most significant. The program was created to improve on-the-job conditions and to foster acquiring expertise during the entire working life with funding and healthy practices.

Lifelong education plays an important role in the employability of seniors and their performance at work (Chamahian, 2016). This was officially recognized by European institutions at the EU Council of 1995, and several strategies and guidelines were then developed. At the national level, France invests a lot in professional education—€32 billion in 2010, or 1.5% of the GDP. The goals of this investment are varied: “securing professional trajectories on one hand, while allowing individuals to find a new job more quickly if they are unemployed; promoting professional mobility on the other hand, while allowing workers access

to new qualifications” (Ferracci, 2013, p.3). But the results are “unfair and inefficient,” since training is more easily accessible to those better qualified and since effects on productivity and employment are minimal.

In other European countries, however, these educational tools are more evolved and efficient. Two model examples are Belgium and Sweden, which “offer education for adults with the goal of improving their qualifications on the job market and potentially allowing them to go back to school” (Charles, 2016, p.9).

5. Aging and Health

5.1 Changes in Health Expenditure

5.1.1 *The Effects of Health Expenditure on Society*

Health expenditure constitutes one of the first indicators of progressive dependency in developed countries. The portion of public spending on health care tripled between 1960 and 2008, from 3.8% to 11.2% of the GDP. Although demographic aging contributes to increased health expenditure in France, the inverse is also true. Actually, the increase in life expectancy of the French population over the past several decades is due in part to a significant improvement in environmental health in homes. This improvement is largely a result of a substantial increase in public health spending in the French economy. In other words, increased life expectancy illustrates the payoff of public health spending (Ragot, Chojnicki et. al., 2016).

It is also important to remember that aging only accounts for a portion of increased health spending. Changes in medical practices can contribute to a rapid increase. For a given age and morbidity, medical practices have, in fact, changed, resulting in increased health spending. In reality, changes in practices have a massive effect on this increase, with an influence 20 times greater than that of aging (Dormont, 2011).

Thus, increased health spending is not the result of an exogenous phenomenon beyond our control caused by an aging population. It is a set of consequences, rather, of public policies directed in favor of medical innovation.

In regard to whether medical innovation and the resulting health benefits could, in return, reduce health needs and thus decrease expenditures, recent studies respond negatively (Lubitz, 2005; Murphy, 2006). In reality, the cost of an innovation in this field surpasses savings resulting from better health. Decreased morbidity is compensated by a longer life, which implies a longer life period subject to medical expenditures (Lubitz, 2005).

5.1.2 *Quantifying Health Benefits and the Value of a Statistical Life*

Health care is not a good or service included in the GDP beyond the cost of care, which represents only a small portion of its total cost. The notion used to quantify improvements in health and longevity is called the *value of a statistical life (VSL)*. This tool is used to direct public policies during certain arbitrations. However, decisions made on this issue are generally

improvised and opaque due to a lack of explicit criteria and a concrete unit of value. The VSL helps illustrate the contributions of medical innovations (Murphy and Topel, 2006). Using this tool, we have learned that massification of cataract operations generates an average profit of \$95,000 for an average cost per operation of \$3,000. The cost-benefit analysis allows us to better define the health care packages covered by social insurance. Generally speaking, the VSL quantifies the monetary value created by improved health and longevity. Research conducted in the United States (Murphy and Topel, 2005) demonstrates that between 1970 and 2000, increased life expectancy likely contributed the equivalent of 32% of the GDP. Annual profits from health expenditures would then be greater than their cost. This margin assumes that the United States health care budget can be inferior to its optimal value from the society's point of view (Dormont, 2011).

5.2. Dependency

5.2.1 Theories on Dependency

In the context of a health paradigm centered on infectious diseases, increased life expectancy was long considered an indicator of communities' overall improvement. As the center of gravity has progressively shifted from sanitary issues to chronic degenerative diseases, this assertion has been overturned (Robine and Jagger, 2004). Many scientists have tried to determine whether increased life expectancy is positive or negative as far as health is concerned.

There are three schools of thought:

- The expansion of morbidity theory (Gruenberg, 1977) hypothesizes that a worsening state of health correlates to longer life expectancy. Actually, longer life expectancies without disability advance more slowly than life expectancies themselves. So the result is a greater number of years spent living disabled. It has been demonstrated that a decrease in mortality is caused by a decrease in the fatality of chronic diseases rather than a decrease in their incidence or progression (Gruenberg, 1977). As a result, it can be extrapolated that increased life expectancy fosters the development of more severe chronic illnesses, in the elderly in particular. Gruenberg coined the name for this phenomenon during the 1980s as the "pandemic of mental disorders and associated chronic diseases and disabilities" (Gruenberg, 1991).

- The compression of morbidity theory (Fries, 1980) asserts that an improvement in population health will result in increased life expectancy. According to this theory, life expectancy with disability increases less quickly than life expectancy in good health, and so the number of years spent dependent decreases.
- The dynamic equilibrium theory (Manton, 1982) proposes that the portion of years spent in good health remains stable overall. The decreased fatality of chronic illnesses is connected to the decrease in advanced stages of these illnesses. Less fatality leads to longer lives with chronic illness, but also to a decrease in the severely disabling effects of these illnesses.

The concept of dependency can be viewed from many angles (Cambois, INED 2010):

-restricted activity

-need for aid or assistance

-functional limitations due to altered bodily functions.

Recent research suggests that dependency increases as a function of age (Gisserot, 2007) (Charpin, 2010). As was previously discussed (see above), increased life expectancy fosters the development of degenerative diseases and therefore dependency. Thus, either disease or aging causes functional limitations that would lead to limited activity if there were no access to technical assistance or accommodation. This definition of the concept of dependency illustrates that disease, dependency, and disability are closely related (Plisson, Villemeur, 2012).

A distinction must be made, however, between the concepts of dependency as it is used in France and that of Long Term Care, used in English-language literature. The former includes the need for assistance from a third party to accomplish basic daily tasks (Duée and Rebillard, 2004). Long Term Care designates health care services required over the long term. Additionally, French academic literature only applies the idea of dependency to people aged over 60 years, while Long Term Care traverses all age groups. This semantic difference is not a trivial one, as it limits and complicates the pertinence of certain international comparisons. In addition, this specificity of the French system, which separates dependency from disability, is reflected in government benefits allocated to the disabled. At an equal level of disability, these benefits are significantly more generous than those paid to people living with dependency (Plisson and Villemeur, 2012).

5.2.2 The Extent and Scope of Dependency

The primary tool used to identify dependency in France is the AGGIR grid (autonomy, gerontology, iso-resource groups). This grid classifies individuals considered dependent into 6 groups using 15 eligibility criteria. The classification determines the personalized autonomy allocation (APA) that the government will pay out. The AGGIR grid is also used by private insurers.

The most recent research measures between 706,000 and 1,257,880 dependent individuals in France (Dos Santos and Makdessi, 2010). In 2009, 1,117,000 people received the APA.

The amount of very elderly people (80 years of age and up) is quickly growing due to longer life expectancies and aging baby-boomers. According to the INSEE (French national statistics bureau), there were 3 million people in this age group in 2007, and this number will reach 8.4 million in 2060. If health conditions remain the same, the number of people living in dependency at age 75 could increase by 70% in Europe by 2030.

5.2.3 The Cost of Dependency and Intergenerational Aid

In France, public spending on dependency constituted 1.22% of the GDP, or €24 billion, in 2010 (Charpin, 2010). In comparison, private and supplementary insurers finance dependency at up to €200 million per year. This small proportion of public spending on dependency is poorly justified by the relative immaturity of the market, which is only 15 years old.

Informal contributions complement professional aid to finance dependency care. These contributions generally come from the family and provide a free substitute for professional aid. Today, the falling number of informal contributors should increase the financial risk of dependency over the coming years (Plisson, 2014). We note that informal contributions usually take the form of services (Attias-Donfut, 1995; Wolf, 2000). According to research conducted by the European SHARE survey, the percentage of individuals providing financial aid to dependent parents is under 5% (Attias-Donfut and Wolff, 2007; Bonsang 2009; Fontaine et. al., 2007). This informal aid can decrease the financial risk of dependency and thus should be encouraged by government incentive policies (Plisson, 2014).

The decline of this kind of informal aid appears to be linked to structural factors, such as the well-established trend of falling birth rates, changes in and breakdown of the family structure (i.e. divorce), and geographic separation (Hussem, Erwijk 2016). The logical result is an increase in the cost of dependency covered only by professional financing entities. There are, however, two nuances to this conclusion.

First of all, there is no specific correlation between the amount of aid received by dependent parents and how many children they have (Fontaine et. al., 2007). Thus, what is more important than the number of children is whether or not they have any. If the dependent parents do have children, a daughter has the most significant impact on the amount of informal contributions received (Plisson, 2014).

The second nuance concerns recent studies that attest to the compensatory effect of sibling interactions. Practically, this means that a decrease in contribution from one sibling would be compensated by increased contributions by the other siblings (Fontaine et. al., 2009).

6. Aging and the Financial Markets

6.1 The Changing Demographic Structure and Financial Markets: Review of Literature

One of the many roles of the financial markets is to raise and allocate funds, which are exchanged for stocks, raw materials, currencies, and financial assets. Literature on financial markets is primarily focused on the impact of demographic change on assets markets in terms of prices, volatility, and risk. The basic assumption is that with the demographic shift, there will be more retirees that want to sell more of their assets on the financial markets than they keep. This would result in downward price pressure on these assets.

The traditional neoclassical economic growth model demonstrates that a demographic change reduces the real rate of return if it increases the capital/GNP ratio through aggregate savings. This neoclassical model was developed by Robert Solow and Trevor Swan independently in 1956. It is an exogenous growth model that incorporates capital accumulation, population or labor growth, and technological progress. The model easily demonstrates that when the marginal product of capital is approximated as the real return rate, there is an inverse relationship between the real return rate and the capital/GNP ratio. There is no distinction made between labor supply and population size. Thus, an increase in available capital relative to labor supply (or population size) will reduce capital returns. Bosworth et. al. (2004) illustrate this theory using the demographic change due to baby boomers. As baby boomers arrived on the job market, labor supply increased relative to capital, which, in turn, became less available. This led to an increase in the real return rate. The following generation, Generation X or the baby busters, which had a lower birth rate, reduced labor growth, and at the same time reduced real return rates as capital became more readily available. Lower real return rates could lead to short- and long-term bonds performing poorly, low dividends, or minimal price appreciation for stocks. This analysis highlights the varying stock prices across different types of savings, a result of demographic change and its influence on the availability of capital. Then, a second type of analysis connects the financial markets to demographic transitions by the possession and composition of financial asset portfolios.

Mankiw and Weil (1989) were among the first to study changes in population structure and variation in asset prices. Using American household survey data, they establish that the demand for residential real estate for those aged less than 20 years is negligible, that it rises significantly for those aged 20–35 years, and then falls for those aged over 35. Increased

demand (due to, for example, a growing proportion of 20-35-year-olds), then, should be reflected in the construction of new real estate or price increases for existing real estate. Their prediction turned out later to be false. On the contrary, it was observed that residential real estate prices in the United States shot up during a time when they should have fallen, with downward pressure from a change in the demographic structure.

Other studies, such as that of Schieber and Shoven (1977), focus on assets on financial markets to in turn analyze the effects of population structure by age. These authors seek to understand the implications of dissaving on a large scale for the prices and profits of assets in pension funds. The general intuition regarding this issue is that economic agents must diversify their portfolios as they mature. This intuition, however, is not based on theoretical models of optimal portfolio allocation according to which allocation is independent of the age of the economic agent (Merton, 1969; Samuelson, 1969). Poterba (2001) conducts an empirical analysis of the investor's age and asset holding, either direct holding, or indirect holding via a collective investment fund that invests in securities or a defined contribution pension fund. The portion of net financial worth represented by regular assets increases for those aged 40–44 years and barely decreases at all after age 60, and is maintained at the same level observed for those aged 45–49 years. Equity investment, however, does increase for those aged 55–59 years. Poterba's other estimations indicate that demographic structure has a weak effect on the profitability of short- and long-term government bonds and normal stocks. The correlation only seems to exist for short-term bonds without risk. In the same vein, Davis and Li (2003) estimate the effect of the portion of 20–39 year-olds and 40-64-year-olds in the population on the annual variation of the real prices of stocks and long-term bonds. Using a sample of seven OECD countries (United States, Japan, Germany, France, United Kingdom, Italy, Spain), they observed a growth in stock prices as the portion of those aged 20–39 and 40–64 in the population increases. Taking the United States out of the sample, the effect on stock prices is almost identical between the two age groups, but with the United States, the effect with the 20–39 group is half that of the 40–64 group. This last group holds more company stocks. On the other hand, the effect of an increased proportion of 20-39-year-olds tends to push up bond prices, while the effect is the opposite with the 40–64 group. Other studies have demonstrated that the demographic structure of the population has an effect on prices and profitability on the stock markets, but these cases are rarely beyond reproach and can change according to time, country, and demographic structure specifications.

Once again, Poterba (2004) looks to understand the effects of demographic transitions on asset profitability, value, and the demand for various financial products and services. The

econometric regressions that he runs on short-term and long-term bonds and big companies' stocks reveal a weak correlation with demographic structure. The results are essentially the same for short- and long-term bonds, with coefficients that are not statistically significant different from zero, but that suggest that a demographic transition would reduce bond profitability. Conversely, the effect on stocks points towards increased profitability, even though none of these coefficients is statistically significant different from zero. Poterba also conducts an analysis of changes in portfolio composition as a result of demographic transition. The logical reaction to expect is that with the demographic transition, households will accumulate less financial assets, and thus either maintain or deplete their wealth. There will then be a demand for financial products covering aging risks. In establishing an age-based profile of asset or debt holding, Poterba found that the probability that a household owning their home had taken out a mortgage in 2001 was 60% for those aged 55–59 years, then dropped to 30% for those aged 70–74 years. He also made projections for 2020 and 2040 in order to determine which assets households would retain according to the age of the head of house. For those aged over 65 years, stocks represent 20.4% of their portfolio, which should increase to 31.4% in 2040. Growth is similar for bonds, but not for mortgages, which do not vary to the extent that stocks and bonds do. The demand for annuity products increases with age. The projection indicates an increase from 50% in 2001 to 64% in 2040. Households that take out annuity contracts increase from 2% for quadragenarians to 10% for septuagenarians. This increase in demand reveals the importance of financial products that cover aging-related risks, as well as that of long-term care insurance products. Davis (2006) extends the primary results observed for OECD countries to emerging economies. In a sample of 72 countries, demographic transition first benefits stocks as the 40–64 year group increases in size, and then it's bonds that gain the upper hand when the over 65 group becomes the majority.

The similarity of results between OECD countries and emerging economies can be explained by the fact that these data also pertain to emerging countries, but only to those at an advanced stage of demographic transition. However, there have not been many studies conducted on developing and emerging economies. Most of these countries do not have very advanced financial markets, and the demographic transition there is only just beginning. Over the next few decades, however, there will be a significant increase in the over 60 age group. According to the UN's 2015 report on world population, in 2030 the over 60 age group will have increased by 71% in Latin America and the Caribbean, 66% in Asia, 64% in Africa, 47% in Oceania, 41% in North America, and 23% in Europe. Senior citizens will account for more than 25% of the population in Europe and North America, 20% in Oceania, 17% in Asia, Latin

America, and the Caribbean, and 6% in Africa. These figures demonstrate the extent to which the demographic transition will quickly be felt in all corners of the globe. Existing analyses deal more with the issue of increasing health expenditures in developing countries. They also highlight the importance of reforming existing financial markets so that the needs of senior citizens can be taken into account. In order to do so, the general consensus is that financial markets will have to provide appropriate products and services to support the demographic transition. Although families and the government have traditionally supplied services to the elderly, the demographic transition will weigh on both developed and emerging economies in such a way that the financial markets will be required to create new products and services or improve those they already offer. Before discussing the solutions proposed by the financial markets to face the uncertainties of an aging population, a presentation of the different kinds of pension systems is pertinent.

6.2 Pension Plans

To distinguish between the different kinds of pension plans, Bialès (2014)⁴ suggests beginning with the different types of pension systems: external and internal. In external systems, pensions are viewed from the social protection system's side. Sapir (2005) uses the equity and efficiency criteria, and based on whether they are high or low, categorizes European social systems in 4 categories: the continental model, with high equity and low efficiency; the Anglo-Saxon model, with low equity and high efficiency; the Nordic model, with both high equity and high efficiency; and finally the Mediterranean model with both low equity and low efficiency. Pension systems are derived from their social protection systems, which are in turn a product of the country's social system, still according to Sapir. Amable (2005) established a similar typology. A pension system has 5 main objectives: efficiency or security, fairness, solidarity, free choice and clarity, viability, and reliability. Efficiency means ensuring enough revenue for retirees. When retirees' revenue is measured in absolute terms, the system uses assistance-based logic (à la Beveridge) if the efficiency goal results in the natural principle of a subsistence-level lump sum. The system uses insurance-based logic, however (à la Bismarck) if the efficiency goal creates a safety net. On the other hand, if retirees' revenue is measured in relative terms, the efficiency goal appreciates either starting from the instantaneous relative pension rate (relationship between the pension received and the current revenue of the

⁴ Christian Bialès, Honorary Professor of Economics and Management, Montpellier, www.christian-biales.net

corresponding occupation), or starting from the replacement rate (relationship between retirees' average pension and the average salary of the workforce for the instantaneous rate, or relationship between either gross or net first year pension and gross or net salary of the last year working before retirement for the rate relative to the last salaried year). The fairness goal applies the equal treatment principle and takes into account the level of contribution. The solidarity goal has to do with lump sums or intertemporal, intragenerational, or intergenerational redistribution. The free choice goal deals with issues of supplemental pensions, the possibility of combining retirement and an occupation, and the age at which pensions are received. Finally, the clarity, viability, reliability goal seeks to establish a pension system that is both transparent and credible.

Germany, Belgium, France, and Luxembourg have a continental social model, based more on insurance logic. These systems have a lot of social spending, primarily for unemployment compensation, a highly regulated job market, and a protective termination law. Ireland and the United Kingdom use the Anglo-Saxon model, where the protection system is minimal, resulting in huge social and salary inequalities and a very unregulated job market where unions have little power. The Nordic model boasts a very strong social protection program, little social inequality, and strong unions. This model is used by Denmark, Finland, the Netherlands, and Sweden. The Mediterranean model, used by Spain, Greece, Italy, and Portugal, is distinguished by extensive social spending, low unemployment compensation, and a termination law that is also rather protective.

Internal classifications distinguish four types of pension systems. A division is made between required and voluntary systems, another between pay-as-you-go systems and funded systems, yet another between contributory benefit systems and lump sum benefit systems, and finally those using defined benefits and defined contributions are classified separately.

In pay-as-you-go systems, pensions are financed by contributions levied from the salaries of the working population, which are immediately paid to retirees. The funded system is financed by creating reserves that are the sum of contribution flows paid by future retirees and the financial product generated by those reserves. In this type of system, current workers save for their own retirement. Comparing the two, these systems have rather similar macroeconomic effects: a levy on the GDP. However, while the levy comes from work revenue for pay-as-you-go, it comes from capital revenue for funded systems. The ability of financial markets to ensure asset values and revenue payment is thus a determining factor for funded systems, whereas households' confidence in the government's ability to ensure intergenerational solidarity is the basis of the pay-as-you-go system. As far as profitability is

concerned, the return rate of the pay-as-you-go system is assimilated into the economic growth rate, and the return rate of the funded system is assimilated into the real interest rate. The funded system could lead to an economic risk with changes in the inflation rate, a financial risk with uncertainties on the financial markets, and a management risk if management funds fail. Pay-as-you-go systems are also subject to an economic risk due to changes in payroll and unemployment contributions and a political risk, primarily in terms of legislation or intergenerational solidarity. Impact on the job market will depend on the actual retirement age and the employment rate. When facing external shock, reactions could either be similar or different between the two systems. In the case of a demographic shock, the funded system will suffer from an increased number of retirees compared to the employed population, and the pay-as-you-go system will see returns on income and profitability rates reduced. A financial shock would primarily affect pensions of current retirees.

A pension system is said to have contributory benefits when contributions paid in and benefits paid out are proportional. Benefits are lump sum if they are identical for all beneficiaries, regardless of their contributions paid. Finally, a defined benefits system sets a pension amount to be attained, and benefits paid to contributors are adjusted according to this amount. Conversely, in a defined contributions system, contribution amounts are fixed, and pensions to be paid are neither known nor *a priori* guaranteed. In this case, the insured carry all risks.

6.3 Financial Markets and the Risks of Demographic Transition

All pension systems, no matter the form they take, are exposed to risks, some of which have been mentioned in the preceding paragraphs. Benne (2016)⁵ describes these risks, distinguishing external risks from those internal to the system. As far as external risks are concerned, there is the demographic risk which surfaces when contributors decrease relative to retirees. The economic risk comes from an unfavorable situation that could endanger revenues. The legislative risk has to do with the modification of texts that regulate the pension system. The financial risk comes from the repercussions of a financial crisis. If resources are either directly or indirectly appropriated by the government, this is called the public seizure risk. The political risk is due to a time inconsistency issue in the government. Internal risks include poor management risk, accounting risk, actuarial risk due to uncertainty in life expectancy (when

⁵ <http://fr.irefeurope.org/Analyse-et-evaluation-des-systemes-de-retraites-par-les-risques,a4106>

retirees' life expectancy increases more quickly than expected), lack of personal pension rights for retirees, risk of errors in pension payment, and the risk of opacity in terms of how the system works, etc.

With the demographic transition, aging populations, and particularly increased life expectancies for retirees, pension fund managers need to find solutions in the face of ensuing risks. Actually, the relative weight of pension funds' investments increases with aging. In their September 2006 issue on Finance & Development, the IMF indicated that defined benefit pension plans experience the negative impact of aging, which is worsened by the decreased profitability of stock markets and low interest rates. As was previously discussed, for defined benefit plans, governments and pension funds carry the risks, primarily market risks (interest rates, stocks, and credit), inflation risks (reduced or no inflation), and coordination of investments to longevity (survival after pension depletion). Changing to defined contributions plans transfers these risks to households. The financial markets can then intervene efficiently to better mobilize savings and long-term investments and manage duration, inflation, and longevity risks. Products like a reverse mortgage are meant to create long-term savings and a revenue flow from life annuities. The *viager* is a real estate asset sales contract by which the buyer pays the owner a life annuity for the rest of the seller's life, while a reverse mortgage is an alternative to the *viager* through which some of the asset's capital can be extracted (Ogg, 2012). In the case of a reverse mortgage, the borrower receives funds in the form of capital or an annuity. A mortgage guarantee is required, which consists of a principal amount plus capitalized interest. Debt is capped at the value of the real estate asset estimated at the end of the term. At this time, if the asset has increased in value and is worth more than the debt, the surplus is paid to the borrower or their heirs, or if the asset has lost value, the loss is taken by the lender (the bank).

With other markets managing longevity, tools to deal with health care costs and changes in property prices must also be developed. To guard against the risk of longevity, insurance companies and pension funds can use longevity bonds or a longevity swap. A longevity swap is a transaction by which a pension fund exchanges, with one or several reinsurers, the real life duration of its retirees for the time they are insured with their real life duration. It is neither a transfer of assets nor an end to payment, but an agreement between a transferor and one or more reinsurers on the risk due to longevity on a block of annuities. This agreement is thus made on long-term risk and an open portfolio, while the securization process transfers the longevity risk to the financial market.

The market covering health care costs is poorly developed on the capital markets, with private insurers and the government as the primary managers. This management, however, is being transferred towards households and health care plan sponsors. The property price risk is also real, but this market is either inexistent or just beginning, except for in the United States. Falling property prices could be harmful for retirees, so coverage against this risk is essential.

Conclusion

Ultimately, economists' research on the demographic transition is very active and studies all microeconomic and macroeconomic effects of this demographic shock. This research establishes several observations.

The first is that public policies are not very advanced; they have done a poor job anticipating this phenomenon. Demographers have forewarned of this tendency for 50 years and economists have been working on it for 30 years, but public opinions in the affected countries have had little to say about this shift and appropriate public policies have been implemented only with difficulty.

The second observation is that the aging phenomenon is only beginning and that increasing dependency rates will now be an impressive constant.

The third observation is that the equilibria that have been maintained until the present must now be questioned. In this vein, the health expenditure trajectory can no longer be explained by technological changes. After a certain level of technology, economies of scale could possibly be achieved. At the same time, the portion of people aged 80 years and older in the population will increase considerably. It is thus likely that health care costs will change according to aging more so than they have in the past. This is even a certainty on many other markets such as real estate, savings, or the job market.

It is these four markets in particular that the Chaire TDTE decided to explore, thus making them its four priority research foci.

1. Focus on Securization

One of the research foci of the Chaire TDTE is the securization of real estate assets. We know that the differences between senior citizens' revenues can be greatly reduced by using real estate as a pillar of the pension system (Bogatal, 2015 and Delfani, N., De Deken, J., & Dewilde, C. (2015). Thus, we can predict that tools such as life insurance or life annuities should be developed in European countries as a response to aging.

In the United States, establishing reverse mortgages through the HECM public insurance program solved this problem. The development of reverse mortgages allowed individuals to liquefy their real estate assets and turn them into additional revenue, benefiting both property owners and retirees, in particular. The advantages of this system are letting the

occupant stay in their home, allowing them to retain a portion of ownership, usually around 20% of the assets, and providing them with additional revenue from the securitization of their mortgage. This system, by which real estate assets can be liquefied, is made possible by the different statute that mortgages have in the United States as compared to countries using the Napoleonic Code. It is also a result of greater trust placed in the financial market and limiting banks' roles, both in real estate financing and in the economy in general.

Another advantage of this system is that revenue from mortgages securitized in this way is inversely related to interest rate increases, while revenue from the pension fund increases as interest rates rise. The combination of a pension fund and a real estate asset allows for diversification of retirees' portfolios, which will likely decrease the volatility of their revenue. This works when pension funds invest more in company stocks than in government bonds.

The situation in Europe (except for the United Kingdom) is different, since mortgages are property assets and not financial assets, and since pension systems and life insurance contracts are invested in government bonds for reasons pertaining to prudential regulations.

An interesting path would be to adapt real estate assets to aging by facilitating transfers or donations, by creating *viager* loans intermediated by a public authority (Masson), or by creating a financial market for real estate property assets. The basic idea is that these assets would generate more immediate revenue for seniors and then be transferred to the younger generations in advance, according to the average age of inheritance. Since pension plans and life insurance in Europe are primarily invested in bonds, it would be best if liquidity from real estate wealth came from tools mainly invested in productive entities, either directly, for example in companies created by the younger generations, or indirectly via specialized banks that would invest liquidated assets in stocks rather than in bonds.

It is of note that many Chinese economists (Yan An, 2008; Yuche Chen, 2014), confronted simultaneously with a rapidly aging population and an immense property bubble, suggest adopting a securitization of real estate property assets like in the United States.

The establishment of these tools must be preceded by a rigorous risk analysis. Actually, property prices should fall as a function of aging. This rather intuitive phenomenon has been observed in many countries (for an international comparison, see Kiohiko Nishimura, 2011).

In order to perform well, the system must thus combine the possibility for additional revenue for retirees with investments by the working population in the economy.

2. Focus on Saving for Retirement

The Chaire's current project in the saving for retirement focus is a study of pension funds and economy financing, led by Enareta Kurtbegu and Huyen Nguyen from the University of Maine. The goal is to study the impact of funded retirement systems on economic dynamism. The previous project, which has been finished, studied pension reforms, and the authors, Audrey Desbonnet and Thomas Weitzenblum, conducted an analysis of the impacts of different pension benefit systems on household savings in the context of an increased dependency ratio. Several studies have previously been completed on the following subjects: the implications of transitioning towards a required retirement savings system in France by Didier Folus, *viager* loans adapted to both wealthier social groups and those less well off by André Masson, the *viager* as a tool for liquefying wealth and increasing consumption by Julien Navaux and Alain Villemur, the taxation of wealth and intergenerational transfers by Luc Arrondel and André Masson, family changes and private transfers by Silvia Macedo, an analysis of previous pension system reforms in France by Didier Blanchet, and systematic reform by Antoine Delarue.

3. Focus on Second Chance Programs

In an aging society, life expectancy increases, as well as the length of an active life. With the retirement age being pushed back, a new approach to time at work has developed. This means that career mobility is becoming more important, as people envision being able to evolve in their professions.

This fact must be taken into account, as the literature reveals that satisfaction at work has a serious impact on workers' productivity and that human capital can compensate for loss of cognitive skills (Levasseur, 2015a). Lifelong education must thus play an important role, particularly when it leads to a diploma. It has been demonstrated that the loss of productivity in senior workers is less important if their level of education is higher (Crépon et. al., 2016). In addition, education is a means of re-joining the workforce that can be used in the fight against unemployment in our society, for both young and old.

For all of these reasons, the Chaire TDTE introduced education as a research focus, in particular the idea of second chance education: giving people time to themselves to reorient their careers and improve their skills and knowledge using the AFU program (a year of universal education) (Lorenzi, Villemeur, Xuan, 2016; Lorenzi, Xuan (under the direction of), 2013). The definition of this measure and its impact on the economy is currently being studied,

as the Chaire TDTE supports this initiative and believes strongly that it can have a positive effect.

4. Focus on Health

Facing predictions of an increase in health expenditure by up to 3 percentage points of the GDP by 2060, researchers at the Chaire TDTE are committed to finding long-term solutions to health care financing. Concerned about preserving intergenerational solidarity, the Chaire's members seek to re-balance the financing of the health care system between generations (Lorenzi, J-H; Villemeur, A; Xuan, H., *France, le désarroi d'une jeunesse*. Eyrolles, 2016). Using their unprecedented macroeconomic growth model, MELETE, researchers Xavier Chojnicki, Jérôme Glachant, and Lionel Ragot are determining the effects that different types of social protection financing will have on economic growth and generational well-being (Chojnicki, X; Glachant, J; Ragot, L., *L'impact du financement de la protection sociale sur la croissance*. Chaire TDTE, 2013). The pertinence of the MELETE model allows us to have a quantitative and documented debate on the optimal model to finance health expenditures. Researches Lionel Ragot and Xavier Chojnicki can refine the model's effects on well-being according to generation and level of qualification. In 2016, after having identified the determining factors of retirement as they affect health (Barnay, T., *Quelles trajectoires de santé des seniors après la retraite? L'effet des conditions de travail et de vie*. Chaire TDTE, 2016) and having determined the impact of health expenditures on the French economy (Chojnicki, X; Delattre, E; Ragot, L., *L'impact des dépenses de santé dans une économie vieillissante*. Chaire TDTE, 2016), the Chaire TDTE, using taxation, will now attend to making health care financing equitable once more.

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