Replicating Intergenerational Risk Sharing in Financial Market

Enareta KURTBEGU[1]

Work in collaboration with: Cardano Risk Management
Rotterdam, Netherlands
Supervisor: Stefan LUNDBERG

February 14, 2014

Abstract

Intergenerational risk sharing is often seen as one of the strengths of the Dutch pension system. The ability to absorb financial and actuarial shocks through the funding ratio allows for smoothing of returns over generations. Nevertheless, this implicitly means that generations subsidize each other, which has its disadvantages, especially in the light of incomplete contracts. In this paper we highlight the advantages of intergenerational risk sharing and investigate if and how much of this can be replicated in the markets. By using a stylized model based on different pension plans such as hard DB, conditional DB, DC, collective DC and individual investing, this study concretely identifies the effects of demographic (life expectancy, fertility rate), macroeconomic (inflation, interest rate) and financial (no-mean reverting returns) shocks. Furthermore, we investigate whether it is possible to construct a financial instrument that could be used to smooth returns over a certain period. This paper makes a step towards creating better DC products in countries that don't have CDC pension schemes; and to help improving the design of today's CDC pension schemes. Finally, these results could be seen as an input into the policy and recommendation discussion investigating potential improvements to second pillar pension schemes in Europe.

Keywords: Intra/Intergeneration risk sharing, CDC, generation fairness.
JEL Classification: H55, G11.

[1] University of Evry-Val d'Essonne, Department of Economics, EPEE, TEEP-CNRS. Address: 4,Bvd. F. Miterrand, 91025 Evry Cedex, France. Tel: 01 69 47 71 57. E-mail: enareta.kurtbegu@univ-evry.fr

Diamond (1977), Gordon and Varian (1988) and Ball and Mankiw (2001) among others, theoretically showed that the inability of the current generations to share their risk with those who are not yet born makes markets inefficient. Therefore, the absence of any intergenerational sharing of individual risks implies that workers face high uncertainty on their future pension income. The inability of the markets to efficiently allocate risk across generations has been used to argue in favor of more public interventions such as introducing sophisticated pension schemes and an appropriate use of financial instruments. Cui, de Jong and Ponds (2009) showed that in the collective pension contract, exist welfare enhancing features related to the intergenerational risk sharing not only in the government PAYG but also in the in funded plans. The fairness in the pension plan is an important issue. Lindbeck and Persson (2003) define it as the marginal return on contributions equal to the market interest rate while Borsch-Supan (1992) determine it as a zero net benefit independent of the age a person enters the retirement stage.

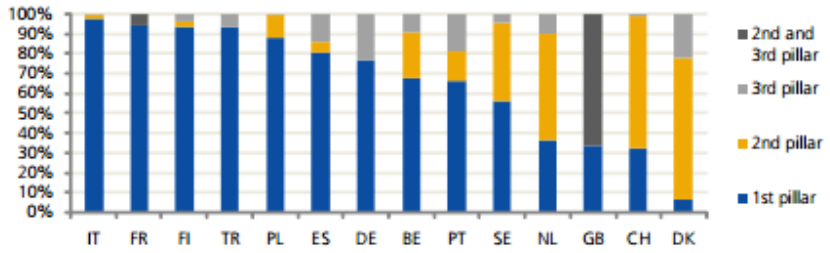
The European Retirement System is best described along the three-pillar structure used by both the OECD and the European Union. The *social security*, considered as the first pillar involves publicly state-run pension schemes with defined benefits and PAYG financing, based on payroll tax. These schemes are organized on national basis and are in general unfunded PAYG schemes, preponderant in the Bismarck countries such as Germany, France, Italy and Belgium. The second Pillar, "occupational *pensions*", consists on privately managed pension schemes. These plans are typically three-party contract that involves the employer, the fund and the employees (active and retired members). The Pillar II is dominating in those pension systems where the first pillar only provides the basic support for everyone considered as usual assistance to provide the standard of leaving at or just above the poverty level. Countries in which the second pillar is predominant and main complementary in the pension calculations are called Beveridge countries including its birthplace Great Britain, Spain, most of Scandinavia and New Zealand. The annuity schemes and the individual savings are part of the third pillar denoted the "*individual saving schemes*". Its role is to encourage individuals to save if they wish to complement/increase their pension income. Saving may be done through insurance companies, it may be fully individual or it may involve any kind of asset. Based on individual saving, employers have no role and the participation of the pension funds is not involved. A long-term trend is that the historical distinction between second and third pillar solutions is disappearing. For instance, it is now common in many countries that work place pension schemes in the second pillar are individual saving schemes or insured solutions.

Using the three pillar categorization helps explaining the pension solutions in the different European countries. One of the extremes is Sweden (similar for the other Scandinavian countries, such as Denmark) where the first pillar pension has been extended and includes an income related part for all wage-earners and salaried employees. This extended first pillar is a social redistribution scheme known as Notional DC. As a result, the second pillar solutions have a relatively small share of the expected pension payments in Sweden. The contribution to the second pillar solutions are determined by nation-wide collective agreements on pension schemes and other retirement provisions. This covers almost all employees (90%-95%) in the private and

public sectors. The total pension premium to the first and second pillar in Sweden is 23% on top of the salary for a mid-income earner. An interesting observation is that there are hardly any traditional pension funds in Sweden. The employee chooses among different pension providers where the typical default choice is mutual insurance companies offering both a collective product and individual saving schemes.

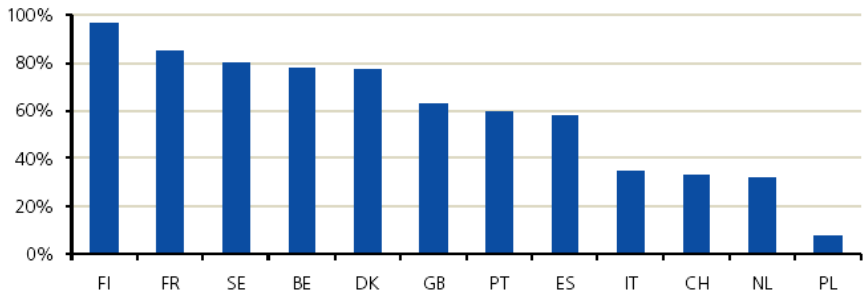
On the other extreme is the pension system of UK, where the state provides basic pension provision intended to prevent poverty in old age. Historically, UK had a strong second pillar with DB schemes giving employees a pension at replacement ratio around 60% of the final wage. Due to the demographic development, this system was not sustainable and over the last 15 years almost all DB schemes have been closed to new members. New employees only have access to third pillar type of solutions with relatively low contribution rates. The minimum regulated contributions in UK are 2% increasing to 8% by 2017. In 2008/2009, the full basic state pension for a single person was equivalent to nearly 14% of his average earnings. This transformation means that the replacement rate going forward will be much less than in the past. Recently, the Department of Work and Pension has introduced the auto-enrolment reform which demand that each company has to offer a workplace pension scheme.

The total pension premium include the premiums paid to insurers, pension funds and banks for pension savings, but also the contributions made by employers and employees to the social security system. In some countries the contribution was estimated on the basis of the benefits paid out to retired persons. This allows estimating the relative size of each of the three pillars in terms of their contribution to pension schemes. The following graph illustrates the proportion of the three pillars measured as percentage of total premium.



Source: The role of insurance in the provision of pension revenue, CEA Insurers of Europe, CEA Statistics N° 28, September 2007.

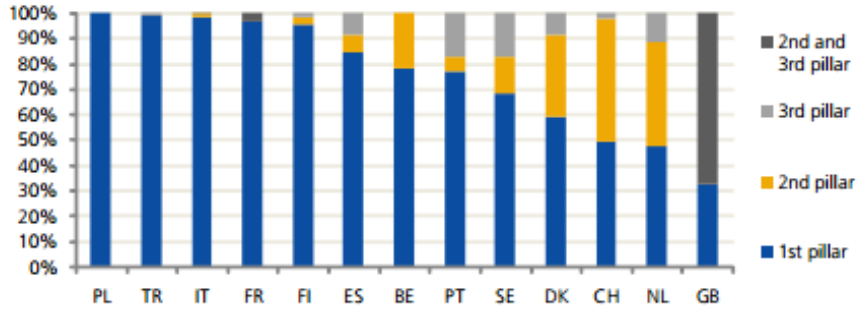
As we can see, there is no split available between the 2nd and 3rd pillars for France and UK but it has been estimated. For UK, the second pillar corresponds approximately to 140% of the first pillar premium income. The third pillar is calculated as the difference. For France, the repartition between the second and the third pillar has been estimated to 50%-50%.



Source: The role of insurance in the provision of pension revenue, CEA Insurers of Europe, CEA Statistics N° 28, September 2007.

This graph shows the share of insurers in the second and third pillars premium income. One could conclude that the market share of insurers in current the premium income of the second and third pillars is above 50% at almost every market except in Switzerland, Italy, the Netherlands and Poland. The lower share of insurers in the premium income of the second and third pillar for instance in the Netherlands is explained by the predominance of private pension funds in the second pillar.

The benefits paid by insurers, social security and other types of pension institution include all the payments made during the year following a claim, a termination of a contract. The first pillar, the the pay-as-you-go system, remains the largest provider of pension revenue in every country. The second pillar is the main alternative in countries (GB, NL, CH) where the first pillar has a lower market share. Only three countries, Spain, Portugal and Sweden, reveal a market share which is higher in the third pillar than in the second pillar. The following graph gives the shares if each of the three pillars in the benefits paid by all players.



Source: The role of insurance in the provision of pension revenue, CEA Insurers of Europe, CEA Statistics N° 28, September 2007.

It is of interest to study the Dutch model since instead of closing the DB schemes they transformed from hard promises into targeting an ambition. This approach is called "*collective defined contribution (CDC)*" which, at a first glance, looks like a traditional defined benefit pension plan but both the investment risk and the longevity risk are shifted to plan members (employees and retirees). The Dutch system is based on uniform accrual rate where employees build up for each year of service

around 2% of their pensionable wage as new pension rights. Therefore, a career of 40 years gives a pension income of 80% of the average wage over the career. What is interesting with the Dutch system is the intergenerational risk sharing that takes place in the second pillar through the employer-based supplementary pension schemes. Moreover, the risk sharing mechanism allows that the risk is not borne by the employer but by the collective, implicitly by the employees.

The original DB schemes completed the market for the employees by offering life-long stable real cash flows in retirement. The Dutch system is particularly interesting to study since it does no longer provide a hard guarantee DB anymore and therefore it does not provide a solution to the market incompleteness. In fact, it has become a DC system that uses a DB accounting framework. This is particularly interesting since most of the other countries have opted for having the redistribution in the first pillar and clear ownership rights as well as *ex-ante* fair risk sharing in the second pillar. More precisely, the Dutch system consists of a residence based universal first pillar, quasi-mandatory funded second pillar (mandatory except for some specific industries) and the voluntary third pillar. This system has not managed to avoid sustainability problems. The recent years' challenge is toward the attempts of improving the sustainability of the pension plans in the second pillar. Pension fund as other financial instruments faces the risk of un-sustainability, the mismatch between assets and liabilities. The classical ALM shows that the more risk you take, the higher the expected return is more volatile the funding ratio.

Academic studies point out the enlarging welfare potential of the Dutch pension funds. The welfare improvements are attributed to the intergenerational risk sharing which allows pension funds to take more risk in asset allocation and provide smooth consumption by stable contributions and pension payouts. The ability to absorb financial and actuarial shocks through the funding ratio allows for smoothing of asset returns over generations.

The funding ratio of the Dutch pension fund reached its peak at the end of the '90s followed by a sharp drop in pension funding right during the "dotcom" crisis. The Dutch government imposed supplementary funding requirements in 2002 in order to reduce the risk absorption. The funding ratio slowly recovered from the low levels in 2003 but felt dramatically during the financial crisis (2008) attending the lowest level for a high number of pension funds. The level of trust in these CDC pension plans has decreased and the societal support for the intergenerational risk sharing is not as strong as it used to be. In the case of under-funding, a pension fund can cut the benefits and pension-in-payment to restore its solvency level. It is worth to note that the participation in a specific pension fund is still mandatory for the employee. Currently, there is a debate in the Netherlands on a new pension deal. This deal is even more DC like since the pension age will be linked to the systemic longevity and there will be roof on the contribution level. This research paper should be viewed with in the perspective of the proposed changes to the Dutch pension system.

Focusing on studying the employer-based supplementary schemes (Pillar II) one can ask oneself what would happen to the support of intergenerational risk sharing model when some of the actuarial shocks are not random walk, but have a trend? There have been several

demographic changes over the last 80 years. In 1932, the average life expectancy in the Netherlands was 64. The life expectancy today is 19 years on average after 65. Fertility has decreased and not only do the average women give birth to fewer children but she gives birth to her first child later in life. More young people today focus on getting a higher education which leads to a reduced number of years in working life. Moreover, there is a long-term trend to earlier retirement in many countries while evidence shows that this does not induce a parallel decline in unemployment rates. Given these biometrical and societal developments, one can postulate that what we are facing is not just random walk shocks but there exist societal and demographical trends. Therefore, one may think on how will all these developments affect the fairness of current design with respect to intergenerational risk sharing respectively transfers?

Given that the hard promise is no longer part of the Dutch second pillar, it is important to investigate: *How much of the remaining intergenerational risk sharing in the CDC can be solved by the markets?* In other words, *what is the unique value of the CDC that can't be achieved via the markets?* We are interested to study what exactly happens in the CDC pension schemes in terms of remaining intergenerational risk sharing. How much is this risk sharing unique and how much can it be replicated by the markets? How can one make the pension deal fair for the young generations and still retain some intergenerational risk sharing? If nowadays, the intergenerational risk sharing is no more considered as the strength of the Dutch pension system, what are the incentives of the new generations to participate in? What would happen if the mandatory participation in a specific pension fund is more flexible allowing for individuals to choose their own fund?

The current Collective DC pension funds could be described as a "black box" in which redistribution takes place, but it is not really clear what really happens in this "black box". Which are the risks that are actually shared and to what extent they can be replicated by the markets? Therefore, providing answers to these questions would lead us to better understand the real value of the proposed pension contracts. We will investigate the common arguments in the literature and the Dutch debate regarding the intergenerational risk sharing by analyzing a stylized pension contract in the Netherlands. We will explicitly identify the different types of risks that are shared among generations in the CDC setting.

Moreover, we investigate how each of the intergenerational risk transfers are affected by demographics trends, such as fertility and longevity, financial shock such as no-mean reverting returns and macroeconomic shocks such as inflation and interest rate. Finally, the outcome of this study is used to provide insights that will help creating better DC products in countries that don't have CDC pension schemes; and to help improving the design of today's CDC pension schemes. Therefore, one could see the results of this paper as an input into the policy and recommendation discussion where it could be used to investigate potential improvements to second pillar pension schemes in Europe.

We build a stylized pension contract considering different pension plan such as the hard DB plan, the conditional DB plan, the pure DC plan and the CDC plan. Three types of CDC are

calculated such as the conditional indexation of pension benefits based on a standard ladder policy, based on the ladder policy where cuts are applied and based on the ladder policy where cuts and surplus distribution is applied. The population is based on real Dutch population data, while simulated scenarios for the term structure (Vasicek one-factor model), stock returns (Black and Scholes model), bank account interest rates (risk free returns), price inflation and wage inflation are used for the calculating the pension plans.

We compare the pension plan results to the individual investing, using a value based method for calculating the generation account per cohort and in total. Moreover, we use the Gompertz law to model the population. The population shock in terms of increase in life expectancy (modal age at birth) and population growth (in terms of fertility growth) is characterized. Finally, we measure the utility of the retired agent at each time for each contract. It is modeled such as a contract giving a net wealth being lower than the fair value induces a higher reduction in the agents utility than a contact giving the same contract surplus. One of the main issues is defining what a fair contract is and *ex ante* calculating it.

In this study we want to measure the difference between participating in a pension contract *vs.* individually investing the amount supposed to be contributed in the pension fund. The pension fund characteristics such as the nominal and real funding ratio, the probability of underfunding, and the replacement ratio are calculated. The classical asset liability model and the value based approach (cohort and non-cohort specific) are used for each pension plan to measure the effects of the applied shocks.

Literature:

[1] Ball L. and N. Mankiw, Intergenerational Risk Sharing in the Spirit of Arrow, Debreu, and Rawls, with Applications to Social Security Design, *Working Paper 8270, National Bureau of Economic Research*, 2001.
[2] Black F. and M. Scholes, The pricing of Options and Corporate Liabilities, *Journal of Political Economy*, 81(3), 637-654, 1973.
[3] Borsch-Supan A., Saving and consumption patterns of the elderly, *Journal of Population Economics*, 5 (4), 289-303, 1992.
[4] Broer P., T. Knaap and E. Westerhout, Risk Factors in Pension Returns, *Netspar Panel Paper 21*, 2010.
[5] Cui J., F. de Jong, and E. Ponds, Intergenerational Risk Sharing within Funded Pension, *Journal of Pension Economics and Finance*, 10(1):1-29, 2008.
[6] Gollier C., Intergenerational Risk-Sharing and Risk-Taking of a Pension Fund, *Journal of Public Economics*, 92(5), 2007.
[7] Gordon R. and H. Varian, Intergenerational Risk Sharing. *Journal of Public Economics*, 37, 1988.
[8] Z. Lekniute, A Value-Based Approach to Pension Plan Redesign in the Netherlands. Who will gain and who will lose, *Master Thesis, University of Tilburg and APG*, 2011.

[9] Lindbeck A. and M. Persson, The gains from pension reform, *Journal of Economic Literature*, 41 (1), 74-112, 2003.
[10] Ter Rele H. and C. Labanca, Lifetime Generational Accounts for the Netherlands, *CPB Discussion Paper 170,* 2010.
[11] Van Ewijk C., N. Draper, H. Ter Rele and E. Westerhout, Ageing and the sustainability of Dutch Public Finances, *CPB Special Publication* 61, 2006.