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### **Personal Pensions with Risk Sharing, Affordable, Adequate and Stable Private Pensions in Europe**

Bovenberg, Lans; Nijman, Theo

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*Lans Bovenberg and Theo Nijman*

## Personal Pensions with Risk Sharing

Affordable, Adequate and Stable Private Pensions in Europe

DP 03/2015-005

# **Personal Pensions with Risk sharing: Affordable, Adequate and Stable Private Pensions in Europe**

A.L. Bovenberg and Th.E. Nijman<sup>1</sup>

March 2015

## **Abstract**

Private pension provision faces the challenging task of providing stable income streams during retirement. The challenge has increased markedly in the last decades due to volatile financial markets, falling interest rates and the withdrawal of employers and external insurers as risk bearers of systematic financial and longevity risks. Partly because of these developments, policyholders desire pensions tailored to their individual needs. This paper proposes a new type of pension: the Personal Pension with Risk sharing (PPR). By unbundling and valuing the investment, (dis)saving, insurance and risk-sharing functions of pensions, PPRs allow risk management and (dis)saving to be customized to the specific features of heterogeneous individuals. Moreover, unlike variable annuities, PPRs allow investment risks to be combined with longevity insurance without giving rise to high year-on-year volatility in consumption streams or opaque and rigid valuation and smoothing rules. The unbundling of functions in the PPR also deepens the internal markets for financial and insurance products while at the same time accommodating the diverse traditions of countries in terms of occupational pension provision. Finally, the PPR reconciles financial, fiscal and macroeconomic stability with growth by increasing the supply of long-term risk-bearing and illiquid capital, complementing public retirement provision, reducing the interest-rate sensitivity of pensions and smoothing shocks.

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<sup>1</sup> The authors thank Casper van Ewijk for helpful comments on an earlier draft. Errors and misperceptions remain the exclusive responsibility of the authors.

## 1. Introduction

The European Commission advocates private retirement saving to supplement public pay-as-you-go pensions (European Commission (2012)). This would diversify income sources of the elderly, thereby enhancing old-age insurance without making public finances more vulnerable to population aging. At the same time, the Commission looks to institutional investors, including insurers and pension funds as a source of supply of long-term illiquid investment capital. These institutional investors can boost the European economy by reducing the reliance of that economy on bank financing (European Commission (2013)). Unfortunately, the financial crisis has undermined the political support for and legitimacy of existing funded private pension schemes. Reconciling affordability, adequacy and security of old-age insurance through private provision of pensions has been quite a challenge in the turbulent financial markets of the past decade. Indeed, several countries in Eastern Europe have scaled back their private pension plans, in part to meet their short-term fiscal needs.

### *Private pensions in transition*

The landscape of private pension provision is in transition and calls for pension innovation. Employers and insurance companies are withdrawing as risk sponsors of occupational defined-benefit (DB) schemes, which offer guaranteed benefits to workers. Hence, individual defined-contribution (DC) plans, in which risks are borne by individuals, are becoming more important. While life-cycle investments are now common in the accumulation phase, DC plans usually offer little guidance on how to decumulate wealth during retirement. Adequate design of decumulation products requires that the level of the income stream as well as longevity and investment risk exposures are tailored to the specific needs of the individual. Moreover, risk management during accumulation should be integrated with the goals for the decumulation phase. DC plans typically fail in these respects. To illustrate, in many DC plans longevity risk is either not insured or is available only in combination with very specific risk exposures to financial risks (e.g. constant nominal or real income). Moreover, in these products risk management during the accumulation phase is typically not aimed at providing a stable retirement income. Piggott and Bateman (2010), for example, express concern about the inadequate design of the decumulation phase in DC pensions in Australia.

The key question after the financial crisis is thus whether the private sector can supplement public pensions by providing reliable, adequate and affordable income streams during retirement. This paper comes up with an affirmative answer: private pensions can reconcile the three goals of income security, affordability and adequacy in a transparent and flexible fashion, while tailoring pensions to the needs of heterogeneous consumers. A European model of private old-age security can be built by combining the strengths of DB and DC products. This paper proposes an innovation that unbundles the three main functions of annuities and other pension decumulation products: investment, (dis)saving and risk sharing. By combining these functions in flexible and transparent ways, pension providers can customize pay-outs and the associated risks to the needs of heterogeneous individuals.

### *Longevity insurance*

An extensive academic literature on decumulation strategies analyzes the advantages and disadvantages of particular strategies for the three functions of investment, dissaving and insuring longevity risk (see e.g. Davidoff, Brown and Diamond (2005), Rocha et al. (2011), Mitchell and Piggott (2011)). Full insurance of idiosyncratic longevity risk is welfare enhancing if a number of necessary conditions are satisfied. As regards the investment function, full longevity insurance is optimal only if it can be combined with adequate exposures towards systematic risk factors such as equity returns, interest rates and (expected) inflation. Hence, if the insurance market offers only guaranteed nominal and real annuities, full annuitization is typically not optimal (see Koijen, Nijman and Werker (2011)). Horneff et al. (2008) explore the welfare costs of inadequate exposures to systematic risks during the decumulation as well as accumulation phases.

Insuring longevity risk constrains liquidity. Longevity insurance is typically irreversible and cannot be sold because of selection; individuals who sell their insurance because they know they will pass away shortly would undermine longevity insurance. This lack of flexibility in the pay-out and insurance functions associated with longevity insurance discourages individuals from taking out this insurance if these individuals face uninsurable idiosyncratic risks, such as old-age care costs (see e.g. Pang and Warshawski (2010), De Nardi, French and Jones (2011)). Hence, fully insuring idiosyncratic longevity risk is optimal only if individuals can insure also other idiosyncratic risks, such as old-age care and health care.

Another necessary condition for full longevity insurance is the absence of bequest motives. With bequest motives, individuals want part of their wealth to be transferred to their heirs instead of to the insurer, for example through survivor insurance. Also behavioral reasons may explain why longevity insurance is not taken out (Brown et al. (2008)). In addition, poorly functioning annuity markets may play a role. These markets may not function well because of selection: potential policyholders know more about their longevity than insurers do. In addition to selection, opaqueness combined with behavioral reasons may hamper competition. Indeed, the United Kingdom has recently eliminated the obligation to annuitize— in part because of the perceived lack of competition on the market for longevity insurance.

### *The Personal Pension with Risk sharing and its three main features*

We propose the pension innovation of a Personal Pension with Risk sharing (PPR). Three features characterize a PPR, as illustrated by Figure 1. First of all, as regards the investment function, a PPR is personal. Individual property rights involving systematic traded risks are defined in terms of a personal investment account with financial assets. This account grows as a result of contributions and financial returns on the assets (and possibly other returns involving the risk-sharing function; see below), and is depleted by pay-outs. Accordingly, unlike in annuity products, financial property rights and exposures to risks traded on financial markets are

defined in terms of personal financial assets rather than annuity units. Moreover, financial assets are the personal property of individual policyholders rather than the insurer.

The second feature involves the pay-out function. In particular, a PPR aims at providing a pension: the assets are earmarked for financing an income stream during retirement. Risk management is thus aimed at the goal of providing a particular pension (or pay-out) ambition: a stream of retirement income that rises or falls compared to a particular index (such as prices, wages or a nominal amount). In view of the individual property rights on financial assets, this goal of providing an income stream in retirement implies that asset-liability management (ALM) is conducted at the level of the household balance sheet instead of that of the insurer, which is at present the more common use of ALM. Indeed, the personal nature of the PPR allows for the customization of risk profiles, and renders paramount risk management at the household level.

Adequate ALM in a PPR implies that all policyholders feature their own so-called hedging portfolio. This portfolio hedges the impact of interest-rate fluctuations, expected inflation and possibly other risk factors on the cost of providing their pay-out ambition. In addition, each policyholder has a return portfolio. This portfolio trades off, on the one hand, the volatility of income streams due to traded risk factors and, on the other hand, the risk premia on these factors. If individuals exhibit habit formation or money illusion, shocks in the return portfolio should be absorbed gradually in consumption. In this way, individuals can earn risk premia while at the same time limiting year-on-year volatility in consumption.

The third feature of the PPR involves sharing risks (i.e. pooling idiosyncratic risks and trading systematic risks that are not (yet) traded in financial markets). This third feature thus relates to the insurance and risk-sharing functions. As regards longevity insurance, an insurance contract may supplement the personal investment account of an individual. As a result of this insurance contract, the policyholder earns additional so-called biometric returns if (s)he survives. The policyholder pays for these additional biometric returns when the policyholder passes away by leaving the remaining capital in the account to the insurer rather than to the heirs. This insurance contract allows policyholders to consume more during their lifetime and to insure themselves against the risk of living longer than average.

In addition to the insurance contracts, policyholders can add separate illiquid contracts involving non-traded systematic risks (such as changes in survival probabilities (i.e. systematic longevity risk) and changes in (wage) inflation rates) to their individual investment account with financial assets. Furthermore, they may trade risks with future contributors that have not yet entered the risk-sharing pool (see Gollier (2008) and Teulings and de Vries (2006)) through separate agreements on how future contributors share in current risks. Finally, a governing board of a pension fund may be allowed to redistribute resources discretionarily across individual accounts in response to changing macroeconomic environments.

A PPR in principle involves three functions. A specific case of a PPR is a personal pension (PP) in which the insurance function is absent altogether. A PP is thus an individual draw-down product that manages risks to provide a stable pension income. A PPR also individualizes the investment and dissaving functions but organizes the insurance and risk-sharing functions collectively.

#### *Alternative products versus PPR*

A PPR can be compared to four alternative decumulation strategies: (i) guaranteed pensions; (ii) draw-down products without longevity insurance; (iii) variable annuities without smoothing and dynamic investing strategies; and (iv) variable annuities featuring smoothing and/or dynamic investment strategies. Each of these products suffers from drawbacks. Guaranteed pensions do not benefit from risk premia on systematic risks. DC drawdowns do not pool idiosyncratic longevity risks and thus lack biometric returns if people live longer than average. These products also typically fail to hedge interest-rate risk during the accumulation phase. Variable annuities without smoothing result in volatile year-on-year income streams or benefit hardly at all from risk premia. With smoothing and/or dynamic investment strategies, these variable annuities become opaque and difficult to value. Variable annuities also suffer from credit risk and result in solvency requirements for insurers.

A PPR addresses the drawbacks of these alternative products by allowing policyholders to earn not only risk premia on systematic financial and longevity risks but also biometric returns on account of longevity insurance— without giving rise to high year-on-year volatility in consumption streams, opaque and rigid valuation rules and credit risk. Liability hedging and smoothing of shocks produces more stable lifelong retirement benefits without compromising affordability and adequacy. Our innovation thus allows the private sector to continue to provide stable retirement income, even though employers and other insurers are no longer bearing systematic financial and longevity risk.

#### *Institutional innovation: PPR tailored to specific institutional structure*

The PPR can be tailored to the institutional structure and history of a particular country. While lifelong pension income or collective sharing of specific risks is viewed as an important characteristic in some countries, other countries might want to introduce only PP plans (i.e. plans without risk sharing). PP plans assure that suitable levels of pension income can be drawn over a minimum number of years by focusing risk management in the accumulation phase on the goal of providing an income stream.

Governments and regulators can set rules that they judge fit for their country and history. Moreover, the unbundling of functions in the PPR allows various parties (employers, employees, financial institutions, individuals) to play new roles, create new markets and deepen the internal market for financial and insurance services. To illustrate, although employers are withdrawing as bearers of systematic risks in occupational pension schemes, they can continue to play an important role in occupational pensions by addressing imperfections in insurance and financial markets and behavioral issues. Our proposals thus

respect and accommodate corporatist pension traditions in various European countries. Even though commercial insurers no longer necessarily insure systematic longevity risk, they may continue to play a role by supplying PPRs to individuals or groups. They can pool longevity risks and may insure base risk or provide partial insurance of systematic longevity risks. Pension funds can transform themselves into trusted mutual insurers that help their members with financial planning. Indeed, management of financial risk on behalf of workers— the asset management function— has become a key function now that employers and insurers are no longer bearing these systematic risks in occupational pensions.

### *Outline*

The rest of this paper is structured as follows. Section 2 discusses in more detail how our proposal of the PPR works. Section 3 explores the strengths and weaknesses of the PPR compared to alternative decumulation products. Section 4 investigates how the PPR allows for new roles of employers and financial institutions. Section 5 discusses the implications of the PPR for public supervision, market structure and the rest of the economy. Section 6 provides conclusions.

## **2. What is a PPR?**

Figure 1 illustrates how a PPR works. Just as in an individual DC scheme, an individual features a personal claim on financial assets. These assets are the property of the individual; a PPR is a personal account shielded from the investments and (dis)savings of others. A PPR is a *personal* pension. Yet, an individual cannot freely dispose of the funds because the personal assets are earmarked for retirement income and therefore cannot be claimed for consumption before retirement. Accordingly, a PPR is a personal *pension*. As a third element, a PPR may include insurance of (micro and macro) longevity risk and other contracts pooling idiosyncratic risks and/or trading systematic non-financial risks. A PPR is a personal pension *with risk sharing*.

### *Saving, investment and insurance functions*

During the accumulation phase, contributions<sup>2</sup> flow into the PPR.<sup>3</sup> Retirement income is drawn from the PPR during the decumulation phase. In addition, in each period, three types of returns (financial, biometric and non-market returns) add to the account. The financial assets in the personal account generate the financial returns, just as in personal DC plans. The insurance elements in the PPR yield biometric returns. These returns are conditional on idiosyncratic risks faced by the policyholder. With longevity insurance, for example, an owner who survives enjoys

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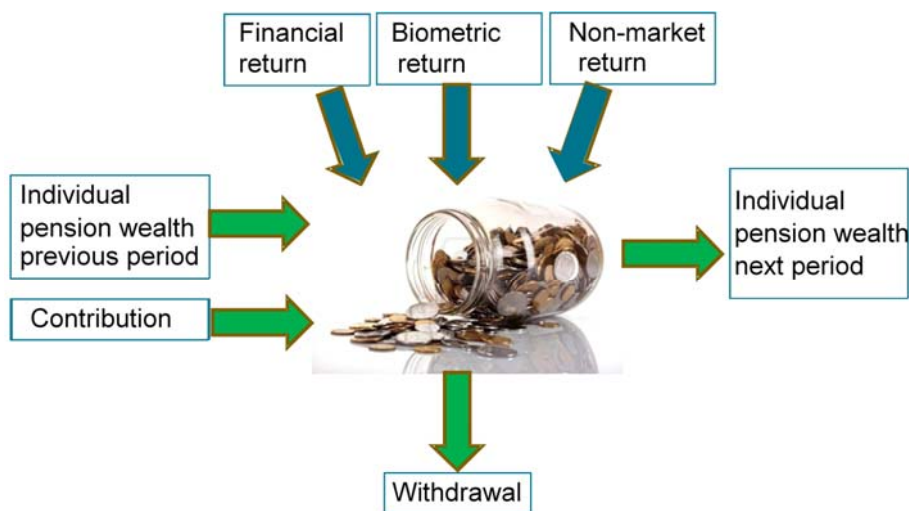
<sup>2</sup> Contribution rates can be either fixed or aimed at achieving a certain pension ambition (e.g., in terms of replacement rate). In the latter case, contributions fluctuate with the macroeconomic environment. In particular, lower interest rates typically signal lower expected future returns, thereby raising the contributions required to achieve a certain pension ambition. Moreover, optimal pension contributions may rise (fall) if realized investment returns on earlier contributions have been lower (higher) than expected.

<sup>3</sup> Alternatively, in some states of the world, part of the contributions could be credited to a collective account or the accounts of other policyholders while contributors in other states receive funds from current policyholders. For these risk-sharing arrangements between contributors and current policyholders, see section 4.



a positive biometric return but the assets accrue to the insurer<sup>4</sup> if the owner passes away. The mechanism for insuring idiosyncratic longevity risk is the same as in annuities. Unlike annuities, however, a PPR unbundles the insurance function from the investment function and in part<sup>5</sup> from withdrawal (or drawdown) function. This allows for more flexible and transparent combinations of functions tailored to the specific needs of heterogeneous individuals. Returns on non-market assets are generated by risk-sharing agreements within the pool written on systematic risks that are not traded on financial markets (such as (wage)inflation).

Figure 1: Personal Pension with Risk sharing (PPR)



Contributions and withdrawals in figure 1 correspond to the (dis)saving function of pensions, financial returns to the investment function, biometric returns to the insurance (or risk-pooling) function and non-market returns to the risk-trading function. The subsequent subsections discuss these functions of the PPR in more detail. Section 2.1 focuses on the insurance function involving management of idiosyncratic risks, section 2.2 on withdrawals, section 2.3 on the investment function involving management of financial risks, section 2.4 on insuring systematic longevity risk and section 2.5 on trading non-market systematic risks. Section 2.6 explains how a PPR can optimally set withdrawals and financial investments on the basis of desired income streams during retirement.

<sup>4</sup> This can either be a mutual insurer owned by the policyholders or an insurer owned by external shareholders. See section 4.  
<sup>5</sup> At the individual level, the function of longevity insurance cannot be completely disentangled from the withdrawal function because of selection.

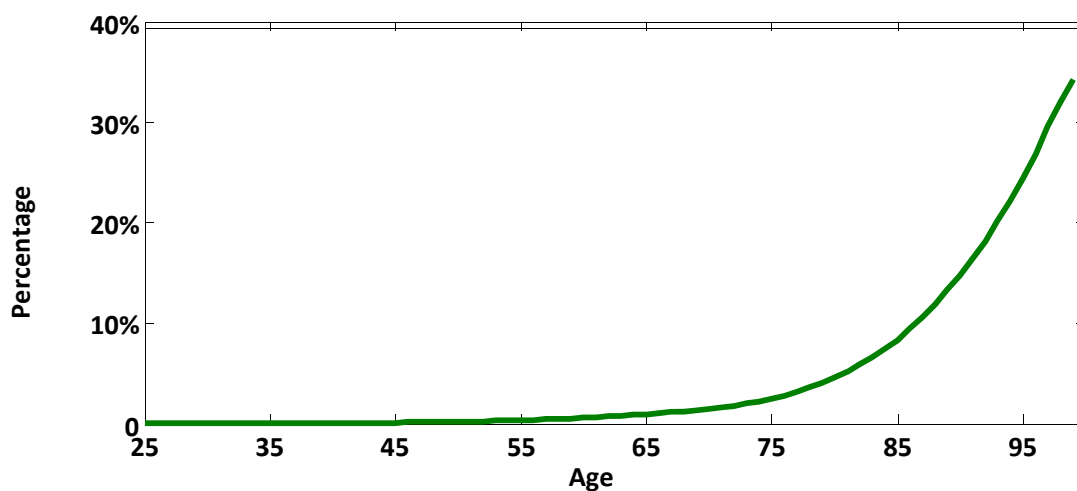
## 2.1 Insurance: pooling idiosyncratic risks

The PPR combines an investment account with insurance contracts. Indeed, the return on the PPR depends on not only financial but also idiosyncratic risks. A PPR can include insurance of longevity risk, life, survivors and old-age care. In that case, a PPR yields a higher biometric return if the policyholder experiences these risks. This section focuses on longevity insurance.

### *Longevity insurance and biometric returns*

With longevity insurance, the owner collects a biometric return if (s)he continues to live. The biometric return can thus be viewed as a bonus for staying alive. This so-called 'longevity return' (or mortality credit) allows a retiree to enjoy a stable retirement benefit with only a limited amount of capital. Hence, a lifelong income stream is affordable. In return for this longevity return if the policyholder survives, the insurer collects the financial assets in the PPR if the owner passes away. The longevity return at life is closely related to the mortality probability and thus rises with age (see Figure 2).

*Figure 2. Projections of mortality probabilities in the Netherlands, 2015*

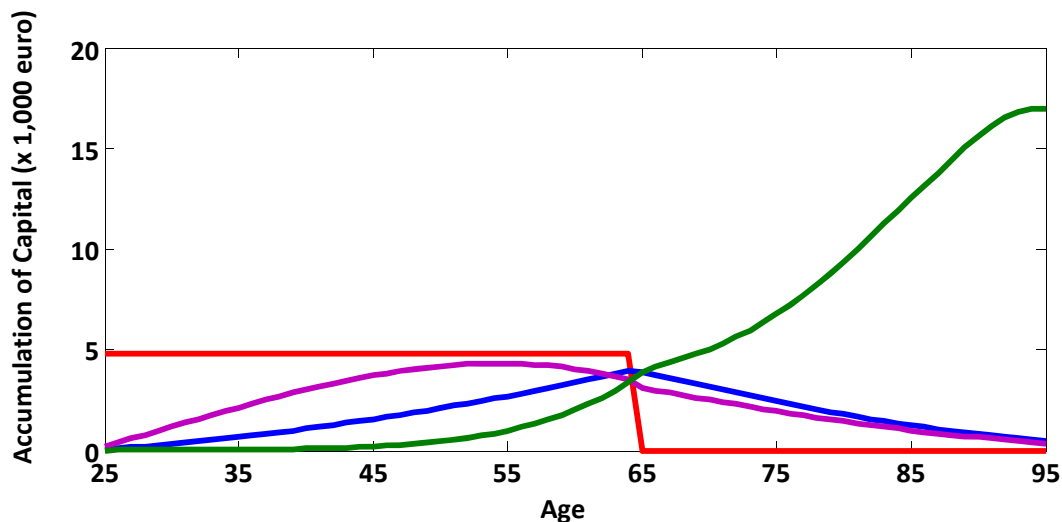


*Source: Statistics Netherlands (CBS), 2014.*

Indeed, the value of longevity insurance in terms of additional returns is particularly large at the end of life, when mortality probabilities become substantial. In this way, longevity returns insure individuals against the risk that they live longer than average. With financial returns dominating longevity returns, a PPR is mainly an investment account during the working life. Later in life, however, a PPR that includes longevity insurance becomes more of an insurance

product yielding substantial longevity returns. The relative importance of investment function versus the longevity insurance function thus shows a life-cycle pattern in a PPR with longevity insurance (see Figure 3).

Figure 3. The accumulation of capital over the life cycle (in real terms).



The accumulation of capital over the life-cycle is specified for the 4 components of capital. These components are pension contribution (red line), real risk-free return (blue line), risk premium (purple line) and biometric returns (green line). Computation assumes a life cycle mix in which the portfolio share of equity declines from 100 % at age 25 to 20 % at the retirement age of 65. The equity share remains at 20 % during retirement. Biometric returns are based on mortality probabilities in Figure 2. The real risk-free interest rate equals 1 % and the equity risk premium is 4 %. The contribution base is constant and equal to 24000 euro during the working life while the contribution rate is 20 %. The pay-out rule sets withdrawals such that expected real payouts are constant during the rest of life. Unexpected shocks are absorbed immediately in retirement income.

Source: Bovenberg, Mehlkopf and Nijman, 2014

#### Stable income stream for fixed number of years

Many individuals are reluctant to insure longevity risk (see Brown et al. (2008), Brown et al. (2013)). A PPR allows a flexible design of longevity insurance during the life cycle. On one extreme, it can accommodate a drawdown strategy without any longevity insurance at all. In that case, the returns on the PPR do not depend on idiosyncratic risks affecting the owner of the PPR. To illustrate, a PPR can provide for a stable income stream during a fixed number of years irrespective of whether the owner of the PPR passes away. Alternatively, it can provide a lifelong benefit without longevity insurance. This lifelong benefit will necessarily decline if the owner of the PPR becomes very old. As another possibility, an owner can buy deferred

longevity insurance for the contingency that (s)he lives longer than a specified age (for example, 85) while pursuing a drawdown strategy without longevity insurance before reaching that age. In that case, biometric returns become relevant only at advanced ages.

#### *Differentiation of biometric returns to combat selection*

When setting biometric returns, insurers may want to segment policyholders based on not only age but also other observable features affecting mortality probabilities. By segmenting groups based on mortality risk and differentiating biometric returns across these groups, insurers can reduce selection and enhance insurance. Compulsory pooling of workers in large, homogeneous groups may also help in this respect.

#### *Potential selection in longevity insurance constrains liquidity...*

As another instrument to combat selection in longevity insurance, the insurer constrains the way the investment account is paid out. These restrictions on withdrawals become especially important at advanced ages when individuals may acquire information that they will soon die. For the same reason, longevity insurance demands that longevity insurance is irreversible. The same holds true for survivor insurance after the survivor has reached a particular age. Otherwise, individuals with low life expectancy will reverse longevity insurance to ensure that their capital accrues to their heirs rather than to the insurer. Also in a PPR, longevity insurance thus comes at the cost of lower flexibility and liquidity, especially for older people.

#### *...and may call for old-age insurance*

Limited liquidity implied by a PPR with longevity insurance provides an argument in support of integrating longevity insurance with old-age insurance. This latter insurance protects older people against idiosyncratic health risk raising their expenses on old-age care. This insurance reduces liquidity needs. A PPR with longevity and old-age care insurance in fact protects elderly persons against not only the risk of longevity but also the risk of living long in bad health requiring old-age care. Such a PPR can thus be viewed as old-age insurance rather than only longevity insurance. Indeed, with both old-age care and longevity insurance, the biometric returns on the PPR depend on not only mortality risks but also old-age care risks. In particular, policyholders experiencing an adverse health shock receive additional biometric returns in order to finance additional old-age care. If insured policyholders do not experience such a shock, however, they pay an implicit insurance premium in the form of a lower biometric return. Bundling longevity insurance and old-age care insurance not only reduces the need for liquidity but also may alleviate selection. This is because longevity and health risks tend to be correlated negatively (see Murtaugh et al. (2001)).

#### *Other insurances during working life*

An individual may want to pay insurance premia out of the PPR also during the working life. Examples are survivor insurance, life insurance and disability insurance. These insurances can typically be added flexibly to the PPR although selection may put some limits on this flexibility. When some capital has been built up in the PPR, the costs of these insurances can be paid out

of the PPR. These insurances may be especially relevant when the human capital of the owner of the PPR is necessary for the livelihood of non-adult children or other dependents. Indeed, insurance makes sense in case of catastrophic risks (i.e. large damages with a small probability). The catastrophic 'risk' in this case is dying at a young age or continuing to live at a high age. The pattern of optimal life insurance thus typically exhibits a life-cycle pattern: as individuals age, they want to buy more longevity insurance (i.e. inverse life insurance that pays out additional funds at life) and less life and survivor insurance (i.e. insurance paying out additional funds at death). They already may want to buy deferred longevity insurance at an earlier age to prevent selection. To illustrate, at retirement, workers may want to buy deferred longevity insurance for the contingency that they become older than average. This longevity insurance is irreversible, to prevent selection. Other insurances (such as health insurance, old-age care insurance, survivor insurance) are more flexible and can be reversed.

#### *Overall biometric returns*

Biometric returns depend on the insurances taken out. Longevity insurance raises biometric returns at life while insurance of survivor, life, health, old-age care and disability reduce the biometric returns if the insured risks do not occur. Whereas overall biometric returns are typically negative in the beginning of life, they become positive later in life.

## **2.2 Withdrawals with exogenous AIR**

#### *Decumulation rate as reciprocal of annuity factor*

The decumulation rate is the share of the personal pension account that is withdrawn at the retirement age, i.e. the age at which the individual starts to draw retirement income from the PPR. This rate is the analogue of the reciprocal of the annuity factor (or conversion rate), which converts a capital sum into a (variable) annuity. Both Assumed Biometric Returns (ABR) (based on the types of insurances taken out; with longevity insurance mortality rates are relevant) and the so-called Assumed Interest Rates (AIR) determine the decumulation rate. In particular, higher ABR and AIR *ceteris paribus* raise the part of the capital that can be taken out at a given retirement age, and imply that market value of the PPR is enjoyed earlier in terms of retirement income (see Brown (2001)). To illustrate, higher ABR on account of longevity insurance without survivor insurance and other bequests raise the decumulation rate. The decumulation rate is raised also by a shorter pay-out period (for example 20 years rather than lifelong). By increasing biometric returns (on the basis of higher mortality rates), a higher retirement age raises the decumulation rate of a PPR with longevity insurance.

#### *Ambition capital as liability*

The decumulation rate ensures that the value of the assets in the PPR is equal to the value of the ambition capital at the beginning of the retirement period. Ambition capital is the analogue of liabilities in a DB scheme. It measures the value of the current income stream on the basis of the ABR and AIR. We take the AIR as an exogenous variable determining the speed of

decumulation. Section 2.6 shows how AIR can be determined endogenously from the desired properties of an income stream during retirement.

### *Mismatch*

During retirement, the income stream is adjusted if the value of the assets in the PPR no longer matches the ambition capital. This mismatch may be due to the asset or liability side. On the asset side, realized financial returns may deviate from the AIR. On the liability side, unexpected changes in ABR (as a result of uninsured changes in mortality tables) or AIR (as a result of changes in interest rates, for example) produce changes in ambition capital.

### *Absorbing mismatch*

In the standard Merton-Samuelson model, individuals optimally absorb the mismatch risk between assets and liability immediately in the form of a permanent change in retirement income for the rest of the pay-out period. Some individuals, however, may like to avoid large year-on-year volatility in their consumption by smoothing the adjustment of income over a longer period.<sup>6</sup> Smoothing of consumption adjustment is also desirable from a macroeconomic point of view.

### *PPR accommodates different ways of absorbing mismatch*

PPR is flexible enough to allow for alternative mechanisms for absorbing mismatch through the pay-out period. One option is to absorb shocks instantaneously in accordance with the Merton-Samuelson model. In that case, the unexpected immediate adjustment of consumption equals mismatch. An alternative option is to absorb shocks gradually by permanently adjusting the growth rate of benefits during the rest of the pay-out period.<sup>7</sup> In that case, shocks result in adjustments in the *growth* of retirement income rather than the *level* of current retirement income. To compute the change in the growth rate, one divides financial mismatch by the duration of the remaining income stream.

Whereas the so-called level method employs the level of the income stream to meet the budget constraint, the so-called growth rate method adopts a time-invariant adjustment of the AIR as the instrument to ensure budget balance. With adjustments in growth rates rather than levels, changes of consumption at the end of the payout period exceed those changes in case of immediate adjustment; larger later changes must compensate smaller immediate changes. Moreover, in case of the growth-rate method, a given mismatch results in a larger annual adjustment in retirement income if the remaining pay-out period over which the shocks can be smoothed is shorter— for example, because an individual enjoying a lifetime retirement income has reached an advanced age.

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<sup>6</sup> Habit formation can explain these preferences, see e.g. van Bilsen (2015). Alternatively, households may suffer from money illusion and experience large welfare losses if benefits are cut in nominal terms.

<sup>7</sup> Alternative options for smoothing mismatch are available. To illustrate, one can use a mix of the level and growth rate options. Another method involves an exponentially declining adjustment of the growth rate over time. One can also adopt different methods for absorbing changes in biometric returns (i.e. ABR) and for absorbing changes in financial returns. In that case, the Financial Adjustment Mechanism (FAM) differs from the Biometric Adjustment Mechanism (BAM).

One can also employ mixtures of the level and growth-rate approaches. Another intermediate solution is to use the aspiration growth rate as the endogenous variable unless this growth rate declines to a certain minimum level. At that point, an individual either starts using the immediate consumption level to close the budget constraint or stops taking investment risk. The latter case involves a guarantee being provided, at the expense of loss of upward potential.

### **2.3 Financial investments**

#### *Hedge portfolio*

The hedging portfolio manages income risk as a consequence of shocks in the decumulation rate. It is defined as the portfolio that hedges the impact of the tradable risk factors (such as interest rates) on the decumulation rate through their effect on the AIR. If the actual portfolio coincides with the hedge portfolio, then financial risks do not create mismatch through the liability side: changes in ambition capital are matched by changes in assets. The hedging portfolio depends on the interest sensitivity of the AIR as well as the duration of the future income flow. Since this duration declines with age, the interest sensitivity of the hedging portfolio decreases as policyholders become older.

#### *Return portfolio*

The return portfolio is defined as the difference between the actual investment portfolio and the hedge portfolio. Shocks in the return portfolio result in financial mismatch. Whereas the hedging portfolio is the safety instrument aimed at hedging the impact of tradable risks on the decumulation rate (i.e. the liabilities), the return portfolio aims at earning risk premia by taking investment risks. A return portfolio on top of the hedging portfolio can make the pension ambition more affordable and/or adequate at the expense of greater risk. The two-fund structure of the PPR with a hedge and a speculative portfolio generalizes the set-up advocated by Ambachtsheer (2014).<sup>8</sup>

### **2.4 Insuring systematic longevity risk**

If they insure longevity risk, individuals can insure themselves against the contingency that an entire generation lives longer than expected at the time the insurance was contracted. In that case, they protect themselves against not only idiosyncratic but also systematic longevity risk (i.e. changes in life expectancy as a consequence of changes in mortality projections). Indeed, just as the hedge portfolio hedges changes in AIR (i.e. future financial returns), insuring systematic longevity risk hedges changes in ABR (i.e. future biometric returns). The insurer typically demands a risk premium for this insurance in the form of a lower biometric return. Indeed, the insurer will have to accumulate solvency buffers as collateral to make this contract credible.

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<sup>8</sup> Ambachtsheer (2014) adopts a specific choice of the pension ambition to be hedged (namely, a fixed nominal pension benefit) and a particular choice of the dynamic investment strategy giving rise to nominal guarantees. The PPR allows for more general hedge strategies and dynamic investment strategies. Indeed, by unbundling the various functions, a PPR incorporates more instruments to tailor the pension product to individual needs.

The PPR allows insurance of systematic risks to be customized to personal circumstances. To illustrate, in contrast to older retirees, workers may not want to hedge systematic longevity risk because increased longevity accompanies lower morbidity and more vitality— and thus more human capital.<sup>9</sup> Workers may also avoid insuring systematic longevity risk because they have to pay a higher price for this insurance; their life expectancy is more fundamentally uncertain than that of older people while the longer duration of their longevity risk increases the risk for an insurer. As a consequence of these considerations, the optimal insurance of systematic longevity risks exhibits under standard assumptions a life-cycle pattern.

## 2.5 Non-market investments

In addition to absorbing systematic longevity risk, an insurer can also absorb other systematic risks that are not (yet) traded on financial markets, such as expected (wage) inflation. These non-financial risks can be traded through separate agreements.<sup>10</sup> With these contracts, a PPR includes a non-market return (see Figure 1). These agreements can be viewed as non-market investments. These contracts, however, may be difficult to implement because the risks cannot be priced objectively, especially if the agreements span a long period. Moreover, since these non-market risks cannot be hedged on financial markets, an insurer may have to carry solvency buffers as collateral to ensure the credibility of these contracts.

Mutual insurers are owned by policyholders. Policyholders in a mutual insurer in effect own a non-market investment in the form of an equity claim in the mutual insurer. These instruments can be classified as being part of the return portfolio in the PPR of an individual. In that case, the business risk of the mutual insurer is distributed in the same way as financial risk.<sup>11</sup> Whereas a for-profit insurer may suffer from potential conflicts of interest between shareholders and policyholders, a mutual insurer has to deal with potential conflicts about the prices charged for new insurance policies between present policyholders (as owners of the mutual insurer) and new policyholders.

## 2.6 Defined ambition: Calibrating AIR and investment from desired income stream

### *Endogenous AIR and liability-driven investment with stochastic pension ambitions*

Up to now, we have taken the AIR as an exogenous variable determining the speed of decumulation and thus the allocation of market value over time. Also the investment strategy was taken to be exogenous. An alternative approach is to derive the AIR and the investment portfolio endogenously from the nature of the desired income stream (i.e. the 'liability'). We call this a Defined Ambition (DA) approach. In particular, the income ambitions can be defined in terms of a distribution with a particular (maximum) volatility and (minimal) expected growth

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<sup>9</sup> The smoothing mechanism for absorbing unexpected changes in biometric returns (i.e. biometric mismatch as a consequence of unanticipated changes in ABR) can be the same as the smoothing mechanism for absorbing financial mismatch. The two smoothing mechanisms (i.e. FAM and BAM) can also differ.

<sup>10</sup> For sharing risks with future contributors or other parties that cannot trade yet on current financial markets, see section 4.

<sup>11</sup> One can also classify shocks in these non-market instruments as part of a separate non-market portfolio with a separate Non-market Adjustment Mechanism (NAM).



rate (i.e. the so-called aspiration growth rate). These parameters may depend on traded risk factors (such as interest rates and inflation). The desired income stream involves also insurance aspects: should income depend on the owner or dependents being alive, for instance? Another aspect of the income stream is for how long is the income stream promised: a limited period or during the rest of life?

Based on a financial model (involving expected rates of returns, volatilities and correlations of the various systematic risk factors) and ABR, one can then compute an efficient portfolio that replicates the desired income stream and yields the maximal AIR. The market value of the efficient portfolio in effect values the aspired income stream.

#### *Trade off adequacy, safety and affordability*

This procedure in effect extends the concept of liability-driven investment and market valuation of promised cash flows from guaranteed DB pensions to stochastic pensions. The market value of the desired income stream is in fact the ambition capital. The cost of this pension ambition ('liability') falls (rises) with the maximum volatility of the desired income stream, the Sharpe ratios assumed in the financial model and the biometric returns (i.e. the mortality risk in case of longevity insurance). The cost rises (falls) with the aspiration growth rate and the ambitions for leaving bequests and/or insuring survivors. The relationship between the pension ambition (in terms of expected income stream and bequests), volatility and costs (AIR) in effect captures the well-known trade-off between adequacy, safety and affordability of pensions

#### *DB versus PPR*

The growth rate of actual retirement income develops in line with the aspired growth rate if realized returns coincide with expected returns in the financial model (and biometric returns do not deviate from expectations). Indeed, assets continue to match liabilities in the absence of unexpected shocks. If shocks are fully hedged and a return portfolio is absent, then a PPR yields a guaranteed pension if systematic longevity risks are insured and the PPR does not include non-market assets. Hence, a guaranteed pension (a DB pension) is a special case of a PPR. However, unless they are infinitely risk averse, individuals like to benefit from priced risk factors by taking priced investment risk and systematic longevity risk. Hence, a DB pension is not optimal. A PPR should thus optimally include a return portfolio taking rewarded systematic financial risks. It should also leave open some systematic longevity risk if insurers charge a price for insuring that systematic biometric risk.

#### *Unexpected shocks as mismatch*

Unexpected shocks in the return portfolio or uninsured shocks in systematic longevity (i.e. in ABR) cause the returns on assets to differ from returns on liabilities. Mismatch in a DA scheme thus corresponds to unexpected shocks. As described in section 2.2, this mismatch can be absorbed in various ways.

#### *Return and growth-rate approach*

The growth-rate method endogenously determines the aspiration growth rate from the budget

constraint when individuals experience unexpected shocks after retiring.<sup>12</sup> With the growth rate approach, DA schemes specify ex ante the volatility of the growth rate rather than the level of consumption. The risk premium in the endogenous term structure of the AIR then rises with the investment horizon because long-term income streams are more risky than short-run income streams. Indeed, to avoid volatile retirement income, liability-driven investment implies that the return portfolio takes less risk when individuals become older because they have a smaller remaining time horizon over which to smooth shocks. Life-cycle investment in which investment risk is reduced with age thus continues in the pay-out phase.

#### *Hedge portfolio and interest sensitivity of AIR*

The specified first and second moments of the desired income stream in a DA scheme determine not only the level of the AIR but also its sensitivity to traded risk factors. In particular, together with the duration of income flows, this sensitivity of the AIR to interest rates determines the extent to which a PPR engages in interest-rate hedging. This hedge portfolio stabilizes the ratio between assets and ambition capital (i.e. the 'funding rate') so that the income stream does not deviate from the pension ambition due to unpriced systematic risks.

#### *Interest sensitivity of hedge depends on intertemporal substitution...*

The interest sensitivity of the hedge portfolio depends on three important factors. The first factor is intertemporal substitution. With positive intertemporal substitution, higher (lower) interest rates raise (reduce) aspiration consumption growth. Hence, the direct impact of shocks in interest rates on the costs of ambition capital (the 'income effect') is offset by changes in the pension ambition (the 'substitution effect').

#### *...pension ambition...*

Also the second factor affecting the interest-rate sensitivity of the hedge portfolio involves the link between interest rates and pension ambition. In particular, if shocks in nominal interest rates are correlated positively with the aspired nominal growth of retirement income (because of, for example, changes in expected (wage) inflation in real pensions), effects on the pension ambition offset the direct impact of changes in interest rates on the AIR.

#### *...and risk premia*

A final determinant of the hedge portfolio is the link between interest rates and expected financial returns. With fixed risk premia (and a fixed pension ambition in terms of desired growth of retirement income), AIR exhibit a one-to-one relationship with interest rates. If expected returns on risky assets are more stable than interest rates and risk premia vary inversely with interest rates, the relationship of the decumulation rate to the interest rate is weakened. This is especially so if the return portfolio is large. Campbell and Cochrane (1999) argue that the equity premium behaves contra cyclically. The assumption of a fixed equity premium then makes the pension system more pro-cyclical than necessary because it

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<sup>12</sup> Note that the aspiration growth rate is exogenously set as part of the pension ambition at the beginning of the pay-out period.

overstates ambition capital in busts and understates it in booms. It also leads to excessive interest-rate hedging. Overall then, the nominal interest-rate sensitivity of the hedge portfolio in real, risky pensions tends to be smaller than that in nominal guaranteed pensions. This is because nominal interest rates are correlated positively with expected (wage) inflation but negatively with risk premia.

#### *Ambition capital and model risk*

If one sets the maximum volatility equal to zero, the ambition capital corresponds to the value of the liability in case of a guaranteed income stream provided by a DB pension plan. With a traded pension ambition, the price of DB pensions can be objectively measured on the basis of tradable instruments. The promised income stream of a DA scheme, in contrast, cannot be measured based on market prices of this income stream if it is specified in terms of its expectation and a non-zero volatility in P space rather than in terms of the distribution of market value over time (i.e. the AIR) in Q space. The reason is that the Sharpe ratios for the various risk factors cannot be objectively measured on the basis of market prices and are subject to model risk.<sup>13</sup> An overly optimistic estimate of Sharpe ratios results in retirement income that in expectation falls short of the aspired growth rate: capital is decumulated too rapidly.

#### *Dangers of defined ambition in distorting preferences...*

Myopic individuals may be tempted to reduce their aspiration growth rate and raise the volatility of their consumption streams to raise the AIR. By thus distorting (dis)saving and investment behavior, they raise their current income levels by reallocating market value forward in time. To avoid these potential distortions, regulators may want to put a ceiling on the AIR or on investment risk. Moreover, pension providers should communicate ex ante about the risk profile.

Another option is to fix the AIR independently of the actual investment risk. More investment risk then leads to a higher expected growth rate of retirement income. In that case, the pension ambition in terms of expected income growth rather than AIR is endogenously determined and depends on the investment risk assumed. Accordingly, AIR that does not depend on the actual portfolio prevents potential distortions in investment behavior but may result in suboptimal intertemporal consumption smoothing. Indeed, this is another manifestation of the familiar trade-off between wrong choices due to behavioral imperfections and lack of discretion to tailor individual choices to personal circumstances.

If longevity is insured and agents have private information about their mortality risk, insurers cannot give older individuals full discretion to set their own AIR. The reason is that agents who know that their life expectancy is short may prefer a high AIR. This selection could unravel

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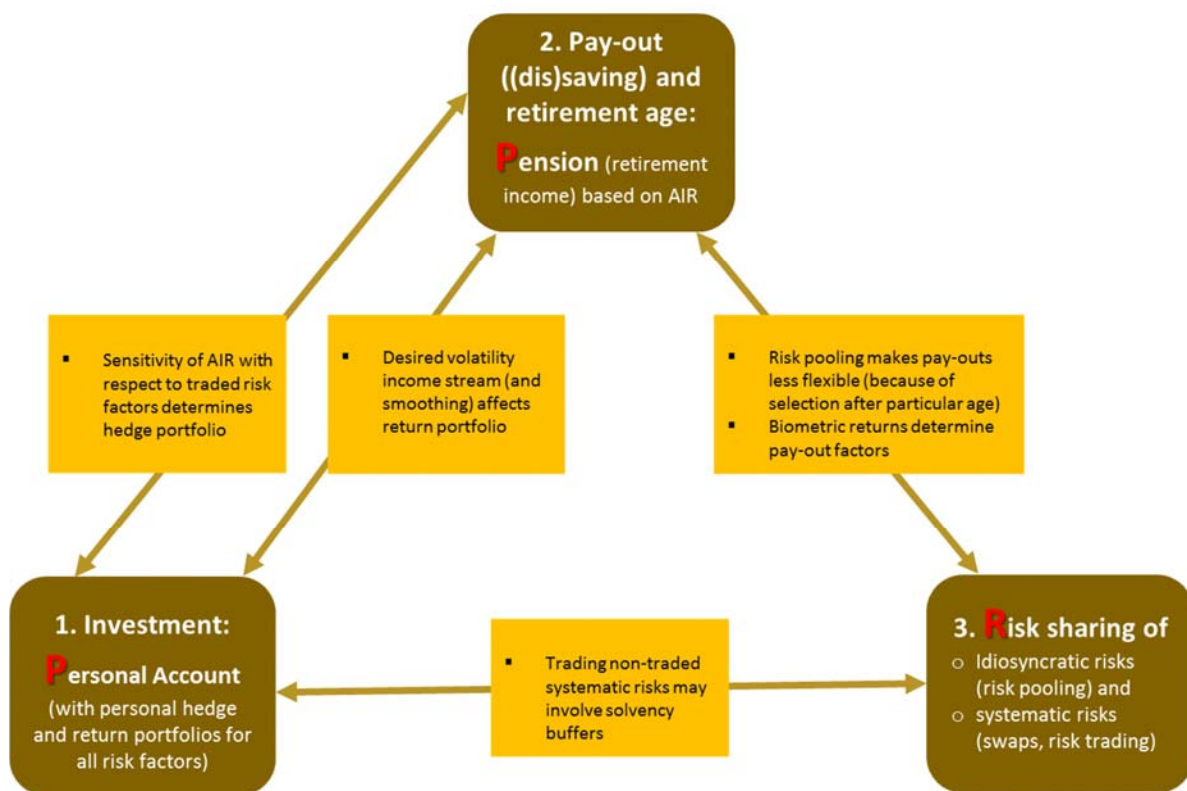
<sup>13</sup> Another reason that ambition capital cannot be measured objectively is that the aspiration growth rate (e.g. wage inflation) is not traded. This, however, is also a problem for DB pension plans in which pension benefits are guaranteed to rise in line with wages.

longevity insurance. Giving individuals discretion about the speed with which they decumulate their capital must thus always remain limited if longevity is insured – especially at high ages at which people typically gain more information about their mortality probabilities. Combining longevity insurance with individual choice in investments is less problematic. Indeed, if investment choice is not systematically related to life expectancy, free investment choice does not create more uncertainty for the insurer in large pools.

...and model risk

Another danger is that individuals or pension providers may strategically overstate Sharpe ratios. Discretionary upward adjustments in the Sharpe ratios reallocate market value from the long run to the short run; retirement income in the beginning of the retirement period is increased at the expense of retirement income at the end of life.<sup>14</sup> Discretionary changes in Sharpe ratios cannot be hedged. A hedging portfolio can hedge only the determinants of the AIR that are traded on financial markets.

Figure 4. Triangle with unbundling in Personal Pension with Risk sharing



<sup>14</sup> These discretionary adjustments, however, do not redistribute resources across generations. This is in contrast to variable annuities offered by mutual insurers (see section 3). In that case, a higher (lower) AIR redistributes resources from younger (older) to older (younger) generations if the mutual insurer does not reset annuity units depending on age.

### **3. Alternative pension designs versus PPR**

This section compares PPR to alternative decumulation strategies: guaranteed DB pensions (section 3.1), drawdown products without longevity insurance (section 3.2), variable annuities without smoothing (section 3.3) and variable annuities with smoothing and dynamic investment strategies.

#### **3.1 Defined-benefit pensions**

Employers are withdrawing as risk sponsors of DB schemes. One reason is that aging of the workforce and maturing of plans has expanded pension obligations compared to the income these firms generate. Guaranteed pension obligations have thus become more expensive in that they result in more volatility in pension contributions compared to core business of these firms. New accounting rules are also stimulating companies to get out of the pension insurance business. These regulations disclose pension risks taken on by companies and thus reveal the substantial costs of DB obligations. Another reason why companies are no longer providing guarantees to DB plans is the increasingly competitive and dynamic world economy. More intense competition implies that companies exhibit shorter lifespans. Firms can thus offer less long-run security to their employees. Indeed, the increased bankruptcy risk of sponsoring companies in a dynamic, more competitive economy implies that workers with DB claims are saddled with substantial credit risk. This increased credit risk implies also that insurance of DB plans by external insurers becomes more expensive. This insurance may result in moral hazard. To combat this danger, insurance authorities have to impose onerous and rigid funding and investment rules on company pension funds.

Buying guaranteed annuities from external insurers is also becoming more expensive for employers and individuals. In the face of rising longevity, insurers are increasingly aware of the systematic longevity risk they take on in the face of rising longevity. At the same time, regulators are tightening solvency requirements. Also low interest rates raise the costs of these guarantees. In addition, individuals are concerned about the bankruptcy risk of insurers, as they have to hand over their capital to the insurer when they buy an annuity.

#### *Advantages PPR*

With a PPR, individuals can earn investment risk premia while at the same time enjoying longevity insurance. Indeed, by unbundling the investment and insurance functions, a PPR provides more flexibility to customize investment profiles in the presence of longevity insurance. Benefiting from risk premia is especially important immediately after retirement, when individuals have accumulated the most pension wealth. A macroeconomic environment with low interest rates renders this even more important. By pooling longevity risks, managing interest-rate risks and smoothing shocks, a PPR prevents volatility of retirement income even

though individuals take on investment risks. Hence, even though employers and insurers are withdrawing as the bearers of systematic risks in DB plans, the PPR allows for stable, affordable and adequate lifelong retirement benefits by not only taking on rewarded systematic risks but also hedging and diversifying unrewarded risks.

### **3.2 Draw-down products without longevity insurance**

Draw-down products do not benefit from longevity insurance. If individuals live longer than expected, they experience a decline in income and/or they have to rely on means-tested government benefits. Hence, individuals and the government carry idiosyncratic longevity risk. To self-insure against this risk, individuals have to accumulate substantial amounts of precautionary savings, thereby making old-age insurance expensive.

#### *Advantages PPR*

A PPR allows individuals to hedge their idiosyncratic longevity risks by generating substantial biometric returns if individuals happen to survive longer than average. Hence, a PPR allows for stable lifelong retirement benefits without necessitating substantial private saving or relying on means-tested public benefits, which tend to generate perverse incentives to save and work less. More generally, by unbundling the investment and insurance functions, a PPR provides more flexibility to customize insurances (such as longevity and old-age care insurance) to individual needs while individuals bear priced systematic risks. By providing old-age insurance, the private sector relieves the government from the burden of providing substantial means-tested benefits to the elderly and being the only party providing reliable old-age insurance.

Another advantage of PPR compared to drawdown products is that risk management in the accumulation phase is integrated with the goal of a stable lifelong retirement benefit as a liability. This risk management at the household level improves the risk-return trade-off: high returns do not necessarily lead to volatile retirement income. Indeed, by deriving the AIR endogenously from the desired risk profile of retirement income, the PPR in effect includes a hedging portfolio that hedges the risk of changes in the AIR due to changes in interest rates and possibly in other traded risk factors. In this way, a PPR in effect applies ALM techniques familiar from managing the risks on the balance sheets of pension funds and insurers in DB schemes to the balance sheets of households.

The Pension innovation of a PPR is an important pension innovation for the decumulation phase of DC plans. Indeed, the 2013 report about the Melbourne Mercer Global Pension Index writes (Australian Centre for Financial Studies, 2013): “The global pension world is changing dramatically in many countries as we move from a DB pension system to one where DC plans are increasing. However this trend has three major shortcomings. First, all the risks associated with private pension plans are borne by individuals. Second, there is an inevitable focus on wealth accumulation (as the member’s account balance increases) rather than on the provision of retirement income. Third, the design of the best portfolio of retirement income products for DC retirees remains elusive. There needs to be fundamental change. We must focus on the

provision of retirement income – after all, that is the purpose of pensions. (...) There is an urgent need to find a better balance between the individual orientation of a DC plan and a collective (or pooled) approach where there is some sharing of risks within and between generations.”

### **3.3 Variable annuities without smoothing**

Variable annuities provided by insurers are one way to reconcile old-age security and adequacy with affordability of private old-age insurance. Just as PPRs, these insurance products provide lifelong benefits with longevity insurance while at the same time taking investment risk<sup>15</sup>. Policyholders thus benefit from both investment risk premia and mortality credits. Unlike PPRs, however, variable annuities lack adaptable, tailor-made investment- and pay-out profiles and typically fail to integrate risk management during the accumulation phase with the goal of providing stable income streams in retirement. Moreover, without smoothing shocks, variable annuities yield consumption streams that feature high year-on-year volatility. This reduces the risk exposure that variable annuities can afford to take, especially if agents exhibit habit formation, loss aversion or money illusion. Hence, retirees cannot earn risk premia for fear of excessive volatility of their income streams.

#### *Advantages PPR*

By unbundling the investment and insurance functions, a PPR allows for more flexibility and more scope for attuning insurance to personal circumstances than variable annuities do. In particular, insurances of longevity, life, survivors and old-age care can be tailored to individual circumstances and preferences. In addition, the PPR allows shocks to be smoothed, thereby reconciling investment risk with low year-on-year volatility of retirement income.

With a PPR, the individual carries less credit risk on the insurer than in the case of a variable annuity. The financial assets of the owner of a PPR are not transferred to an insurer but remain the property of the individual. This contributes to trust and raises the demand for longevity insurance. Moreover, since insurance companies do not take investment risks in their balance sheets, solvency requirements are less strict. Indeed, by unbundling the various risks, PPRs allow solvency buffers to be tailored to the risks that insurers take on.

Another advantage of PPRs over variable annuities is that they adopt the same administrative infrastructure during the decumulation phase as is employed in the accumulation phase. Using the same administrative processes in both the accumulation and decumulation phases helps to contain administrative costs.

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<sup>15</sup> Note that we adopt slightly different terminology than used in other papers. We define an annuity to be for life. Other papers refer to retirement products that generate an income for a fixed number of years also as annuities. Horneff, Mitchell, Maurer and Rogalle (2013) and Hanewald, Piggott and Sherris (2013) are two recent examples.

### 3.4 Variable annuities with smoothing

To prevent high year-on-year volatility, mutual insurers administering self-annuitizing group plans often smooth shocks over time through complex profit-sharing rules and collective buffers. These plans have often emerged from DB company or multi-employer plans from which employers have withdrawn as risk bearer. We call these pension plans without external risk sponsors Collective Defined Distribution (CDC). These CDC plans feature a collective asset pool that is distributed to policyholders on the basis of complex profit-sharing rules. A PPR offers important advantages to these CDC plans in terms of simplicity, transparency, and easy-to-value property rights, on the one hand, and customization to heterogeneous individual circumstances and scope for adapting to unexpected developments, on the other.

#### 3.4.1 Simplicity and transparent valuation of individual property rights

##### *Complex CDC schemes with unclear property rights yield intergenerational conflicts*

In DB schemes in which employers guaranteed annuities, individual property rights in terms of an income stream ('annuity units') had a clear meaning for policyholders. With employers no longer bearing the risks of pension plans, however, annuity rights have become variable annuities. In particular, the annuity units typically vary with the funding rate (defined as the value of all the financial assets in the collective compared to the value all liabilities in the pool), according to a particular distributional rule. A valuation methodology based on assumed interest rates is required to compute the value of the liabilities in this rule.

This valuation typically has no clear relationship with the true market value of risks associated with the variable annuities (see Bovenberg, Mehlkopf and Nijman (2015)).<sup>16</sup> Hence, the purchase of new policies typically imposes external effects on existing policyholders. Moreover, discretionary changes in distributional rules yield non-transparent redistribution across policyholders. The redistribution among stakeholders associated with this opaqueness generates intergenerational conflicts and politicizes the policies of mutual insurers. Indeed, with policyholders supplying risk-bearing capital to the mutual, internal conflicts between policyholders loom— for example, about who should bear what risk at which price. The non-transparency complicates defusing these conflicts through governance of these collective plans.

Variable annuities with profit sharing provided by external insurers are also opaque. These insurers often engage in complex smoothing techniques and dynamic investment strategies that are hard to value. Hence, the pricing of annuity units in these variable annuities is opaque and does not have a clear relationship to the market value of the risks involved.

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<sup>16</sup> Only under certain conditions does the valuation based on the AIR correspond to the market value of the annuity units and can thus be used to determine the price at which contributions can purchase annuity units. The market price of the annuity units is especially complicated if shocks are smoothed out, unless the AIR is the risk-free interest rate and the adjustment rule for the variable annuities is symmetric (see Bovenberg, Mehlkopf and Nijman (2015)).



In order to prevent controversies about valuation and smoothing rules, mutual insurers that smooth shocks often adopt inflexible smoothing rules (based, for example, on funding rates involving a risk-free nominal interest rate as the AIR; see Bovenberg, Mehlkopf and Nijman (2015)). Indeed, changing smoothing periods or the AIR not only affects the pay-out and hedging functions but also redistributes resources across generations. On the one hand, the commitment of a fixed risk-free AIR may prevent a conflict of interest about the distribution of market value within a mutual. On the other hand, however, the risk-free AIR distorts intertemporal consumption smoothing, thereby creating unnecessary volatility of old-age consumption. The interest sensitivity of retirement income associated with the risk-free AIR also hampers the transmission of monetary policy. In addition, this risk-free AIR distorts the hedge portfolio and creates an intergenerational conflict about investment policy of the mutual; older generations prefer more hedging of interest-rate risks than the younger generations do. Finally, the artificial demand for interest-rate derivatives and liquid safe government bonds reduces risk-bearing investments in the real economy, generates additional counterparty and systematic risks, depresses real interest rates for safe instruments (especially those with a long duration) and reduces long-term private investment (Caballero and Fahri (2014)). In fact, governments have had to come up with artificial long-term rates (such as the ultimate forward rates) to avoid the most serious pricing and other distortions arising from the use of a risk-free rate as the AIR for long durations.

#### *Advantages PPR*

Unlike variable annuities with smoothing, the PPR allows investment risks to be combined with longevity insurance without giving rise to high year-on-year volatility in consumption streams or opaque and rigid valuation rules. In particular, a PPR defines individual ownership of financial risks in terms of easy-to-value financial assets rather than future cash flows.<sup>17</sup> Transparent valuation allows for an easily understandable link between individual contributions, financial returns, individual assets and benefits. Pension contributions are paid directly into a personal account from which easy-to-value financial assets are bought. This transparency contributes to the confidence and sense of ownership of policyholders and enhances good governance. In particular, insurers can communicate ex ante about risk profiles and ex post about the difference between realized returns, the realized benchmark return and projected returns.

Clear individual property rights also facilitate the portability of pension rights. A PPR thus fits a flexible labor market with substantial labor mobility. The clear property rights also allow for more homogeneous solidarity pools for pooling longevity risk. In addition, these well-defined property rights reduce the risk that governments can nationalize pension savings. Moreover, workers are no longer exposed to the credit risk of the employer or the discontinuity risk of their sector.<sup>18</sup> Indeed, they hold a direct claim on the financial assets in their personal accounts.

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<sup>17</sup> Valuation of non-market systematic risks is still based on subjective rules suffering from model risk. Also the valuation of the insurance contract is complex. The pricing of these insurance contracts may thus involve cross subsidies (e.g. with uniform pricing of genders). Also the pricing of illiquid assets (such as real estate and infrastructure) is complicated.

<sup>18</sup> This is not the case in the PPR with extensive risk-sharing. In that case, swap agreements may fail.

Discretionarily changing the AIR, for example, does not redistribute value across policyholders. Since policyholders do have a claim on financial assets rather than an insurer, insurers face less solvency requirements. The transparent market-based valuation of a PPR implies that providing collective or individual choice does not impose externalities on others. Hence, individual discretion in determining contributions becomes possible. To illustrate, compared to CDC schemes, a PPR makes supplementary contributions more attractive for workers because these additional contributions accrue directly to their own accounts. Hence, workers can smooth consumption over not only the decumulation phase but also the accumulation phase. Workers may thus be able to take on more investment risk because unexpected shocks in investment returns lead to smaller deviations from the retirement ambitions.

### 3.4.2 Customization and adaptability

*CDC schemes are inflexible and impose a one-size-fits-all approach*

The withdrawal of employers as risk bearers in DB schemes has changed the nature of risk management. Customization of risk profiles is becoming more important because heterogeneous policyholders are the risk bearers. Risk sharing in CDC schemes is guided by one funding rate, which is often based on a fixed methodology for setting the AIR in order to prevent intergenerational conflicts about the AIR. This one-size-fits-all approach does not offer much scope for customizing risk profiles and adapting these profiles to macroeconomic developments. It also leads to potential intergenerational conflicts about investment of the collective asset pool. Moreover, in order to prevent controversies about the assumed rate of return, mutual insurers often adopt a fixed risk-free nominal interest rate as AIR. This reduces flexibility further, thereby intensifying conflicts among heterogeneous policyholders about the investment policy of the aggregate asset pool.

*Advantages PPR: PPR allows customization...*

The market valuation of financial risks combined with the unbundling of functions allows more instruments to tailor the investment, pay-out and insurance functions to individual needs and to adapt these functions to the macroeconomic environment. Indeed, these functions can be customized so as to optimize the trade-offs between adequacy, safety and affordability without giving rise to complexity and controversies about valuation. The market valuation also allows for pricing individual decisions properly. This provides more scope for undistorted collective and individual choice options, which do not impose externalities on others.

*....in investment function...*

As regards the investment function, a PPR allows both the hedging and return portfolios to be tailored to personal circumstances, including age. In the presence of proper risk management, individualizing financial risks in the investment function of a PPR allows for better risk-return trade-offs than in variable annuities. In particular, pooling tradable, non-diversifiable risk in a collective investment pool does not generate a better return-risk trade-off than can be achieved through risk management of individually owned financial assets. At the same time, more instruments for tailoring systematic risks to individual features enhance the risk-return

trade-offs. Indeed, by unbundling the investments of various policyholders, the mutual insurer prevents conflicts about investment portfolios; each generation can construct its own optimal hedge portfolio without affecting other generations. To illustrate, the hedge portfolio can depend on the duration of retirement income and thus the age of the owner of the PPR. Also the return portfolio may vary with age in line with the principle of life-cycle investment.

*.... (dis)saving function,...*

As regards the contribution function, a PPR makes supplementary contributions more attractive because these contributions accrue to the accounts of the contributors. As far as the withdrawal (or drawdown) function is concerned, discretionary adjustments in the way the AIR is set reallocate withdrawals over time without redistributing resources across generations. This contrasts with CDC schemes, in which a higher (lower) AIR redistributes resources from younger (older) to older (younger) generations if annuity units are not reset depending on age. By separating the withdrawal function from intergenerational redistribution, a PPR allows for more flexibility and customization in the AIR and thus the timing of withdrawals. Moreover, a PPR allows shocks to be gradually absorbed into income streams without resulting in opaque and difficult-to-value property rights.

*...and insurance function*

By unbundling the investment and insurance function, a PPR allows greater flexibility and more scope for attuning insurance to personal circumstances than variable annuities do. In particular, longevity and life insurance can be customized to individual circumstances and preferences.

*PPR allows for flexibility and adaptability*

As regards adaptability, the PPR can be adapted in a discretionary fashion if macroeconomic developments or changes in personal circumstances warrant changes in planned intertemporal consumption smoothing or in interest-rate hedging. Similarly, mutual insurers implementing PPRs with extensive risk sharing can discretionarily adapt swap contracts (on non-traded risk factors). If they base those changes on subjective estimates of wage inflation or risk premia, financial markets can start to design tradable financial instruments on these subjective evaluations. In that case, pension providers can hedge these changes on behalf of policyholders.

### **3.5. Disadvantages of PPR**

This section discusses some of the drawbacks of PPR.

*PPR may worsen behavioral imperfections.....*

One of the potential disadvantages of PPR is that it may lead to a call for more individual choice (e.g. choice of the investment strategy, of the provider, and so forth), although agents are not well-equipped for these choices. Indeed, transparency as well as market valuation and proper pricing allow for substantial individual choice. A properly designed choice architecture is thus of

the utmost importance. Below we consider behavioral imperfections that may give rise to second-best arguments against PPR.

*...in risk taking,....*

Compared to the less transparent variable annuities, a PPR may lead to less risk-taking due to myopic loss aversion. Indeed, if agents observe the volatile market values of their capital, they may want to resist risk-taking. To prevent this, pension providers should focus their communication about the PPR on lifelong income streams projections rather than the value of the financial assets in the personal account.<sup>19</sup>

*....in longevity insurance and (dis)saving*

The framing of property rights in terms of financial assets rather than a lifelong income stream may lead to a call to bequeath the assets to heirs rather than to the insurer. Hence, longevity insurance is eroded. Likewise, transparent information on capital simplifies the introduction of options to use the capital for other purposes than retirement income, such as housing adjustments, mortgage repayments or specific healthcare costs. This may endanger longevity insurance through selection and may possibly generate myopic behavior.

*Segmentation of longevity risks*

PPR may also endanger compulsory participation in insurance pools. In particular, differences in decumulation rates originating in different mortality rates across solidarity pools may lead to calls for individuals to be able to choose their own solidarity pool. In CDC plans, differences in annuity rates on account of heterogeneous mortality rates across pools are less transparent than in a PPR. The PPR may thus result in more homogeneous solidarity pools without ex-ante solidarity. Depending on the political perspective, this may be viewed as a strength rather than a weakness. Indeed, more room to structure homogenous risk pools as a result of the portability of PPR may actually increase the legitimacy of risk-pooling. To illustrate, segmenting low-skilled workers with low life expectancy in one homogeneous pool may reduce perverse redistribution from low-skilled workers to high-skilled workers. In this way, a PPR facilitates separating the function of risk-pooling and the redistributive function of pensions.

*Transition*

Last but not least, the introduction of PPRs might imply substantial transition issues if one prefers to close down an existing CDC plan. Conversion to a PPR requires valuation of annuity points. Indeed, this could be non-trivial because the valuation based on the distributional rule may not coincide with the actual market value of the annuity rights. Hence, whereas the new system does not lead to valuation conflicts, the transition to it may lead to a one-time serious conflict about the transfer of annuity rights into the new system. To avoid these issues, one may want to leave the rights accumulated in the old system in the CDC plan.

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<sup>19</sup> For the importance of framing in the context of the annuity choice, see Brown et al. (2008).

#### **4. PPR: who does what?**

##### *New allocation of responsibilities to various parties...*

The unbundling of functions in the PPR allows various players (government, social partners, other groups, employers, financial institutions, individuals) to play new roles. The transparent market-based valuation of a PPR implies that decentralized parties can make choices without imposing externalities on others. Hence, a PPR allows responsibilities to be delegated to decentralized parties, such as mutual insurers, social partners, employers and individuals.

##### *...tailored to national traditions*

At the same time, consistent with the subsidiarity principle, different parties can select and administer the various unbundled functions depending on the institutional structure and history of a particular country. In fact, various parties (employers, unions, organizations of self-employed, civic society, pension funds, commercial insurers, government) can play a role in deciding on a particular function— with the mix of responsibilities being different in each country, depending on its social preferences and institutions.

##### *Various parties play role in setting the saving function....*

We can illustrate the flexibility to allocate responsibilities to various parties with the savings function. The government may set limits for tax deductible pension contributions, social partners may negotiate the choice architecture (including default contributions) and individual workers may opt out of (part of) these contributions. Alternatively, the government can set a minimum contribution rate (as in Australia) or it can force employers to offer a minimum default contribution rate to their workers (as in the UK). The transparent link between contributions and accrued capital in a PPR makes voluntary contributions more attractive for the self-employed, who at present often accrue substantially less pension rights than employees do.

##### *...and insurance function*

The PPR can accommodate different parties arranging risk sharing. In particular, insurance pools may be formed by commercial insurers through competition on the market for individual longevity insurance. Alternatively, social partners or professional groups can form these pools. Also the government (for example, regional governments) may play a role. The government can pool longevity risks in the decumulation phase, while the private sector manages the financial assets in PPR. The public sector then essentially acts as a mutual insurer, while individuals or collectives (for example, organized by social partners) can select asset managers and the risk profile of investments. The premium pension in Sweden comes close to this construction.

##### *PAYG as NDC*

Also pay-as-you-go pensions can be organized as PPRs. Indeed, Sweden organized the accumulation phase of its NDC system this way. Contributions flow into a personal pension account with non-tradable claims on the government. This government debt yields a rate of return related to the growth rate of the premium base. If this non-tradable government debt

were valued, it would become clear that part of the contributions is in fact employed to service the implicit debt in the pay-as-you-go system, due to the gift to the first generation (see Valdés-Prieto (2000) and see Valdés-Prieto (2006)).

*Employers can continue to play a role in occupational pensions...*

Our proposals for a PPR respect and accommodate corporatist pension traditions in various European countries. Although in several countries employers are withdrawing as bearers of systematic risk in occupational pension schemes, they can continue to play an important role in these pensions by addressing imperfections in insurance and financial markets and behavioral issues.

*...in pooling idiosyncratic risks..*

First of all, employers, possibly jointly with labor unions or other forms of worker representation, can combat selection, signaling and screening costs by pooling idiosyncratic risks in homogeneous groups. They can thus alleviate market failures in insurance markets that make idiosyncratic risks (longevity, life and survivor, disability, health, old-age care) difficult or costly to trade. Indeed, employers, rather than insurers, create insurance pools so that workers do not have to pay insurers for this service.

*...and address agency issues associated with behavioral imperfections*

Moreover, in addition to creating pools for exchanging systematic risks that are not (yet) traded in financial markets, they can fight agency issues and create buying power in markets for financial services through procurement and the establishment of trusted distribution platforms. In this way, workers save on marketing and search costs and other transaction costs in retail markets. Finally, as a trusted party, they can address behavioral imperfections of financially illiterate workers (such as myopia) by setting the choice architecture (including default choices), e.g. for contributions, investments, pay-outs and insurances.

*Insurers can play new roles by arranging insurance pools ....*

Even though they no longer necessarily insure systematic longevity risk, commercial insurers can continue to play a role in pension insurance by supplying PPRs to individuals or groups. They can pool longevity risks and may insure base risk (i.e. the risk that realized mortality in the pool does not correspond to the mortality projections) or provide partial insurance of systematic longevity risks (i.e. the risk that mortality projections change).

*...and set up pension platforms to guide individuals in financial markets*

Financial institutions administering PPR may set up pension platforms for bringing together demand and supply sides in markets for financial and insurance services. This platform involves a choice architecture for customers, endeavors to bargain on behalf of clients with suppliers about prices and quality of services and ensures the quality of the services provided. These are especially important services at the end of life, when people experience a loss of cognitive skills. Such services are valuable also at the beginning of the working life, however, when young workers have a low interest in pensions. Indeed, risk management on behalf of workers has

become a key function now that employers and insurers are no longer bearing risks in occupational pensions.

*Pension funds as mutual insurers...*

When employers withdraw as risk bearers, pension funds can transform themselves into mutual insurers in which the policyholders supply the risk-bearing capital. In that case, base risk is distributed across policyholders— for example, by adjusting the biometric returns equally for all policyholders. Involving an external insurer may be attractive for small pools because the base risk is substantial for the pool but diversifiable for the external insurer. Large pools, in contrast, may insure that risk themselves through mutual insurance.

*...with extensive risk sharing...*

As regards the risk-sharing function, mutual insurers can address governance issues by agreeing on distributional rules and prices for systematic or idiosyncratic risks that are not traded on financial and insurance markets. In this case, a PPR includes a non-market return (see Figure 1). To illustrate, resources may be transferred from the PPRs of workers (retirees) to the PPRs of retirees (workers) if wage inflation exceeds (falls short of) a certain level. Also redistribution (carried out, for example, through discretionarily changing particular parameters for collective buffers) can be viewed as extending financial markets. To illustrate, if estimated risk premia decline, resources can be transferred from policyholders with a short horizon to those with longer horizons. One can in effect view this discretion as a way to protect policyholders from systematic risks that cannot be foreseen ex ante.

*..gives rise to trade-off between better risk sharing versus governance issues*

Mutual insurers can extend financial markets, thereby improving risk-return trade-offs, by taking on an additional function of trading non-financial systematic risks. This function, however, may give rise to intergenerational conflicts about pricing because these risks cannot be priced objectively from observed trades. Moreover, solvency buffers may be required as collateral to ensure the credibility of these contracts. Accordingly, mutuals may decide to restrict themselves to the functions of investment, longevity insurance and (dis)saving by supplying only PPRs with limited risk sharing. Such a PPR pools only idiosyncratic longevity risks and does not exchange other non-market risks through separate non-tradable and therefore illiquid agreements.

*Trading risks between policyholders, (future) contributors and employers.....*

Mutual insurers can extend financial markets also by trading risks with parties that do not yet have access to these markets—for example, because they do not hold sufficient collateral. These parties— young workers, employers and future contributors represented by unions, for example (see Gollier (2008) and Teulings and de Vries (2006))—may be willing to trade against better prices than the market. In particular, contributors may allow some of their contributions to flow into the PPRs of others— if, for example, current policyholders fall short of their pension ambitions. As a reward, contributors receive a benefit (for example, in terms of an

additional inflow into their PPRs) if present policyholders exceed their pension ambition. Collective buffers (i.e. assets that are not yet allocated to particular individuals) may implement this intergenerational risk sharing. These collective buffers may also facilitate discretionary redistribution.

*..has become less attractive*

Counterparty risk may make this risk sharing less attractive for present policyholders unless mutual insurers own large collective buffers as collateral. In particular, in good times these policyholders give up excess returns while in bad times workers and employers cannot pay because of lack of collateral. More flexible labor markets and a more competitive economy featuring more creative destruction raise discontinuity risk. Indeed, with more flexible labor markets, workers are less committed to specific firms or sectors. Hence, these institutions have less commitment power to induce workers to adhere to the risk-sharing contract. Moreover, aging and the maturing of pension funds increase assets and liabilities of mutual insurers compared to the premium base and the core business of firms. This makes contributions less effective in absorbing risk, also because contribution rates have reached high levels on account of increased longevity and low interest rates.

*Unbundling the responsibilities of social partners and pension funds...*

As a result of these developments, not only employers but also future generations and young workers are withdrawing as insurers. Hence, current policyholders rather than social partners (i.e. employers and unions) have become the owners of the risk on the balance sheets of pension funds. This calls for unbundling the responsibilities of mutual insurers (that is, protecting the interests of policyholders) and social partners (that is, determining which part of wage costs is used for pension saving). Indeed, this separates the labor law (social partners) from the legislation about financial institutions (mutual insurers). Another advantage of this governance structure and market pricing of new contributions (individual contributions flow into the PPR of the individual concerned) is that it prevents conflicts between current policyholders and contributors about pricing of financial risks.

*...and public and private sectors*

Market pricing of contributions also avoids distortions in the allocation of labor across sectors and firms as a result of sector-specific or firm-specific implicit taxes and subsidies on contributions. Indeed, in many countries, risk sharing involving future generations is limited to public-sector plans. Sharing risks with future generations seems mainly the responsibility of the government. The government can tax the labor earnings of workers without distorting the allocation of labor within the economy. It also has democratic legitimacy to commit future generations to a risk-sharing contract. Limiting the task of mutual insurers to risk sharing between current policyholders without involving future contributors unbundles private and public responsibilities.



## **5. Market structure and public regulation**

### *Deepen internal market....*

Unbundling responsibilities in the PPR creates new markets, enhances competition and deepens the internal market for financial and insurance services. Moreover, it increases the scope for creating a level playing field between mutual insurers and other insurers on the insurance market, and between pension funds and other asset managers on the market for asset management. This helps to deepen the European internal market for asset management and insurance, thereby making funded pensions and longevity insurance more attractive. Enhanced portability of pensions implied by market valuation in PPR also enhances labor mobility. PPR reconciles market integration with diverse traditions in various European countries in terms of who bears responsibility for the various functions.

### *...and more transparent longevity insurance*

Annuity products combine investment, pay-out and insurance functions in one product. Hence, annuity markets are often non-transparent and not competitive. Indeed, a poorly functioning annuity market was an important reason for the government in the UK to withdraw the obligation to annuitize tax-privileged retirement products. More transparent longevity insurance through unbundling in PPR may stimulate the demand for longevity insurance and create more competitive insurance markets.

### *Some limits on competition remain desirable*

Some limits on competition through free individual choice may be still called for in view of the failures of the individual insurance markets (selection, screening) and bounded rationality (such as myopia). To illustrate, to combat selection in the market for individual longevity insurance, forced pooling of workers in a particular sector may be required, thereby restricting the individual shopping right of workers to select their own provider of longevity insurance. Indeed, market and individual failures are rampant in pension provision and thus require additional governance mechanisms to supplement competition and free individual choice.

### *Solvency regulation more limited...*

Compared to DB contracts and (variable) annuities provided by insurers, PPRs require less strict solvency regulations because counterparty risk is more limited. Moreover, insurers do not necessarily offer guarantees. Indeed, individuals do not have a claim on the balance sheet of the insurer but own financial assets that remain their property if the insurer defaults. By unbundling the various risks, PPRs allow solvency buffers to be targeted to specific risks that insurers take on. In case longevity risk is insured at or during retirement, for example, public supervision should still ensure that insurers have sufficient funds to pay the promised biometric returns. Solvency requirements can be harmonized across various types of insurers so that commercial and mutual insurers will face a level playing field.

### *...but still required for mutual with extensive risk sharing...*

We distinguish between mutual insurers with *limited* risk sharing (only idiosyncratic and

possibly systematic longevity risk) and mutual insurers with *extensive* risk sharing (involving other systematic risks or future contributors). For the second type of insurers, more solvency requirements are required to reduce the counterparty risk of the implicit or explicit non-market agreements— especially if these agreements exhibit a long duration. Supervisors should ensure that the underwriters of these non-market agreements have sufficient collateral. The government may also want to constrain the extent to which contributions may involve implicit taxes and subsidies on new contributions and thereby limit the ex-post redistribution of these schemes.

*...but is less of a straightjacket*

Indeed, the government will typically engage in more heavy-handed regulation of a PPR with extensive risk sharing compared to a PPR with limited risk sharing. At the same time, the government can grant the private sector more discretion with PPRs than is the case with variable annuities. The reason is that changes in a PPR do not give rise to redistribution. This contrasts with discretionary changes in the AIR in the case of variable annuities. Moreover, when workers contribute, the implicit tax or subsidy they pay is more transparent. Hence, public regulation is less of a straightjacket in a PPR.

*Public supervision of asset management*

Public regulation should induce pension providers to communicate the ex-ante risk profile of the PPR and the realized risks (compared to the promised benchmark). Providers should communicate about not only about the value of the PPR but also the projected retirement income (in terms of purchasing power), including the risks. Public supervision should ensure that actual investments are consistent with the communicated risk profiles.

*Tax regulations: ceilings on drawdown function in terms of AIR*

To protect lifelong benefits, the government may impose ceilings on the AIR, especially for low incomes that may otherwise profit from means-tested benefits at the end of life. In this context, the government may also want to constrain the minimum retirement age (that is, the age at which the first withdrawals from the tax privileged PPR can be made).

## **6. Conclusions**

### *Beleaguered pension provision in Europe calls for innovation*

Pension provision everywhere is under stress due to aging of the population, increased longevity, weak public finances, more flexible labor markets, more competitive product markets changing the role of employers in pension provision and turbulent financial markets with low interest rates. The European Commission has been calling for increased private funded pension provisions to supplement public pensions and replace banks as a source of long-term financing. Innovation of private pension provisions is required to reconcile the macroeconomic needs of the European economy with adequate, affordable, secure and transparent private old-age insurance tailored to the needs of heterogeneous consumers. The adequate design of the decumulation phase of DC products is, in particular, a major concern (see e.g. OECD, 2013).

### *PPR improves risk-return trade-off*

We propose the innovation of personal pensions with risk sharing (PPR). With PPR, private funded pensions can continue to supply stable lifelong retirement income even though employers and insurers are stepping back as bearers of systematic risks. In particular, individuals can benefit from both financial risk premia and additional biometric returns associated with longevity insurance, tailored to their specific circumstances. At the same time, a PPR produces stable and secure lifetime benefits by pooling idiosyncratic longevity risk, by smoothing and customizing the exposures to systematic shocks and by conducting asset-liability risk management to hedge shocks in future returns. A PPR produces this stability without the income volatility, opaqueness and credit risk associated with variable annuities. During the life cycle of an individual, the character of a PPR changes from a portable financial product during the working life to an insurance product at the end of life, when biometric returns become more important compared to financial returns.

### *Unbundling functions and market valuation generates customization and transparency*

The key to the pension innovation of PPR is the combination of two elements. The first element is unbundling the investment, (dis)saving (or drawdown) and insurance (or risk-sharing) functions of pensions. The second is market valuation of financial risks by defining financial property rights in terms of personal investment accounts with easy-to-value financial assets. The combination of unbundled functions and market valuation of financial risks allows for tailoring systematic and idiosyncratic risks to personal features and the macroeconomic environment. This innovation also facilitates communication about risks and pensions, strengthens individual ownership, prevents conflicts of interest within an insurance pool, and facilitates portability of pensions.

### *The PPR combines strengths of collective DB ....*

The PPR combines the strengths of collective DB schemes and individual DC schemes, and avoids the opaqueness of variable annuities; in fact, individualization of financial risks protects collective risk sharing of non-financial risks. In particular, similar to DB schemes, PPRs engage in

asset-liability risk management by defining ambitions for retirement income already in the accumulation phase. Moreover, idiosyncratic longevity risk may be pooled and investment risk can be smoothed in consumption. PPRs allow each collective to tailor the extent of risk sharing to specific needs and circumstances.

*....and individual DC*

As in DC schemes and in contrast to variable annuities, PPRs feature transparent bookkeeping (of the link between individual contributions, financial returns and individual benefits), clear property rights based on market valuation of financial assets and adaptable investment and pay-out profiles that can be customized to individual circumstances. PPRs also allow scope for more individual choice regarding contributions (e.g. for those who are self-employed) and risk profiles. The direct link between contributions, capital and income also allows for the introduction of options to employ pension capital for other purposes (such as renovating one's home to make it more comfortable at later ages) without complex valuation.

*The PPR reconciles subsidiarity with internal market and portability*

The PPR reconciles unity with diversity. By unbundling various functions, a PPR allows financial markets, financial institutions, employers, governments and individuals to carry out well-defined responsibilities for various functions, depending on the institutional setting, culture and history of a particular country. A PPR thus respects the divergent traditions of various European countries. At the same time, it deepens the European capital market and the internal market for various financial services and insurances, creates a more level playing field between various types of providers on the markets for insurance, asset management and other financial services, and facilitates international portability of pensions.

*Macroeconomic implications: The PPR reconciles growth and financial stability...*

Our proposals for the PPR yield macroeconomic benefits by reconciling growth, macroeconomic stabilization and financial, fiscal and social stability. First of all, by stimulating long-term saving and private risk-taking, private pensions stimulate growth by generating long-term risk-bearing capital. This reduces the reliance of European firms on bank financing and its associated systematic risks associated with mismatch. Hence, growth is squared with financial stability.

*....stimulates risk-bearing investments in private sector...*

Second, by reducing the importance of solvency regulations in pension insurance and thus hedging risk-free interest rates, the PPR reallocates demand of institutional investors away from interest-rate derivatives and liquid and safe government bonds (which are used as collateral for swaps) towards investments in risk-bearing and illiquid investments in the private sector and the real economy (including infrastructure). This stimulates long-term private investment and decreases the artificial pressure on real interest rates for safe financial instruments. Moreover, it renders quantitative easing a more effective instrument to stimulate risk taking and private investment.

*...facilitates monetary policy and complements fiscal policy in macroeconomic stabilization...*

Third, our proposals for the PPR facilitate the transmission of monetary policy more generally by alleviating the perverse pro-cyclical effect of interest rates on pension (dis)saving. Indeed, with smoothing of shocks, PPRs do not require risk-free interest rates to value liabilities (as is typically the case with variable annuities). This allows interest rates to affect the desired growth rate of retirement consumption through intertemporal substitution, thereby enhancing the transmission of monetary policy. Compared to variable annuities without smoothing, PPRs complement fiscal macroeconomic stabilization by absorbing shocks gradually in retirement income so as to avoid volatile consumption.

*...contributes to fiscal stability through reliable private pensions...*

Fourth, PPR contributes to fiscal stability by relieving the government of the burden of providing substantial means-tested benefits to the elderly and being the only party providing reliable old-age insurance. In particular, the PPR allows the private sector to supply stable, affordable and adequate lifelong retirement income even though employers and commercial insurers are stepping back as insurers of systematic risks.

*...and enhances legitimacy of decentralized ownership of capital*

Last but not least, our proposals for a European model for private pension provision can potentially contribute to a more equal distribution of financial wealth in society and thereby to the legitimacy of decentralized ownership of capital. Indeed, private pensions allow a larger part of private wealth to be owned by the middle class. This addresses some of the concerns of Piketty (2014) that wealth disparities are increasing in the western world.

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