Netspar

Network for Studies on Pensions, Aging and Retirement

Netspar DISCUSSION PAPERS

Lans Bovenberg and Casper van Ewijk

The Future of Multi-Pillar Pension Systems

DP 09/2011-079

The future of multi-pillar pension systems

Lans Bovenberg
Tilburg University and Netspar

Casper van Ewijk
CPB Netherlands Bureau for Economic Policy Analysis, University of Amsterdam and Netspar

September, 2011

This paper takes stock of the evolution in pension systems and the challenges that remain for the future. It derives a typology of pension systems and uses this to discuss the strengths and weaknesses of alternative systems. After describing how pension systems in the industrial world have been facing similar challenges, this paper argues that pension contracts in various countries have developed in similar directions. In observing that the way that pensions are organized still differs substantially between countries, the paper discusses that this international heterogeneity is likely to remain in the future. A unique answer to what is the optimal pension system apparently does not exist; several alternative solutions exist alongside each other, depending on the specific historical, political and institutional context of each country.

1 Introduction

This paper takes stock of the evolution in the pension system and the challenges remaining for the future. It describes how pension systems in the industrial world have been facing similar challenges. As a result, pension contracts in various countries have developed in similar directions. At the same time, however, the way pensions are organized still differs substantially between countries. This international heterogeneity is likely to remain in the future. A unique answer to what is the optimal pension system does not exist; several alternative solutions exist alongside each other, depending on the specific historical, political and institutional context of each country. We therefore derive a typology of pension systems, discuss the strengths and weaknesses of alternative systems, and sketch some important challenges for the future.

The rest of this paper is organized as follows. Section 2 describes trends in pension insurance and the key remaining issues and trade-offs based on the analysis in this book. This section concludes that the reform of pension systems in response to common trends is underway but by no means finished. In order to answer the normative question how alternative institutional designs should ideally develop in the future, Section 3 develops a typology of pension systems. Section 4 investigates how the various pension systems identified in this

typology can enhance intergenerational risk sharing. It considers also how these alternative pension designs can better tailor life-cycle planning and intragenerational insurance to individual heterogeneity.

2 Challenges to pension systems: Functions, trade-offs and trends

For each of the three main functions of pensions described in *Designing the pension system: Conceptual framework* (Bovenberg and van Ewijk, 2011) and briefly reiterated here, this section discusses the most important trade-offs in the institutional design of the functions. It then indicates how various trends affect these trade-offs and how institutions have responded to these trends. Finally, the remaining challenges for each of the functions are explored. Table 1 summarizes the trade-offs, trends, responses and challenges. This table may serve as a starting point for our discussion of the challenges of the pension system; we consider each of the functions in turn.

2.1 Life-cycle planning

To take account of intragenerational heterogeneity, pension arrangements should be tailored to specific idiosyncratic circumstances and individual preferences. Heterogeneity typically calls for consumer sovereignty. Unfortunately, however, empirical evidence suggests that households typically lack the basic financial knowledge, computational ability and willpower to implement optimal life-cycle planning and the associated intertemporal financial decisions under uncertainty. Accordingly, various 'internalities' complicate efficient individual intertemporal decision making under uncertainty. Moreover, delegating these complicated decisions to others may give rise to serious agency and governance problems, especially because financially illiterate individuals are poorly equipped to discipline suppliers.

Institutions for life-cycle planning
The government can address myopia and other 'internalities' that give rise to poor individual decision-making in life-cycle financial planning by forcing agents to participate in public earnings-related pension schemes. Alternatively, the state can make private pension schemes mandatory for workers. It can also mandate workers to take out pension insurance while allowing individuals to select their own insurance pool. The drawback of compulsion is that it typically cannot account for heterogeneity between consumers, especially because governments are reluctant to use information on specific features of individuals in setting compulsory insurance levels. To accommodate intragenerational heterogeneity, pension schemes can be tailored to groups of workers with the same specific features (*e.g.* the same type of human capital). Personal pension plans provided by insurance companies and other financial institutions can accommodate individual idiosyncratic features. These retail products, however, are typically substantially more costly than standardized wholesale products, in part due to substantial marketing costs and adverse selection.

Trade-off: choice versus individual failure
A fundamental trade-off bedeviling life-cycle planning is that between tailoring to intragenerational heterogeneity (in terms of individual preferences and circumstances), on the one hand, and containing individual imperfections, on the other hand. To illustrate, high compulsary saving levels with mandatory pooling of longevity risk may prevent myopic behavior and fight inadequate longevity insurance (see Section 2.3 below). At the same time, however, it may force people with low preferences for old-age consumption or those facing temporary borrowing constraints to save too much and to take out too much longevity insurance.

Trade-off: competition versus mandatory pooling
More individual choice increases competitive pressure on pension providers to better accommodate preferences of consumers and to contain costs. However, the more the scope for individual choice is increased and the more the market for pensions becomes contestable, the more suppliers tend to spend on public relations and marketing costs. This raises transaction costs passed on to consumers. Hence, as an instrument to discipline pension providers, the effect of more individual choice raising competition on costs is ambiguous. Indeed, individuals that suffer from imperfect decision making raise difficult governance issues.

Table 1 Trade-offs, trends, responses and challenges

Function	Trade-offs	Trends	Responses	Remaining challenges
Life-cycle planning	• Tailoring to heterogeneity versus containing personal failures • Competition versus lower transaction costs	• Increasing heterogeneity • More demanding consumers • Better ICT	• More choice options • Guided choice (defaults)	• Design choice architecture • Integral financial services
Inter-generational risk sharing	• Risk sharing versus political risk and labor-market distortions	• Ageing and maturing of pension funds • Increasing competition on labor and commodity markets	• More complete risk-sharing contracts • Risk-bearing pensions • Increased and more flexible retirement ages	• Labor market for older workers • Design optimal risk - sharing scheme • Risk management by the government
Intra-generational risk sharing	• Fighting selection versus accommodating heterogeneity • Insurance versus moral hazard	• Increasing heterogeneity in skills and longevity • More elastic labor-market behavior	• Actuarially fair pension systems • Tighter disability and unemployment insurance	• Employability of older low-skilled workers • Optimal mix between saving and insurance

Trends: more heterogeneity, more demanding consumers and better ICT

In the face of growing heterogeneity and more demanding consumers, the first trade-off shifts towards tailoring to individual circumstances. The financial crisis, however, has shown that many individuals are poorly equipped to make financial decisions, thereby increasing the awareness of individual foibles. This increased awareness has shifted the trade-off towards containing individual failures. More individual elements require pension agencies to gather more information about specific relevant features of participants – not only the individual's work history and family status, but also health, financial portfolio, housing status (home-owner or renter), and preferences. Better ICT has improved the possibilities to collect more information about individuals. However, privacy considerations and fears about a 'big brother' type of pension agency may prevent the potential of ICT from being fully exploited. Moreover, financial intermediaries are often not allowed to use individual information in the context of market regulation aimed at preventing risk selection or at ensuring a level playing field with other suppliers that do not have access to this information. ICT , however, may allow other providers to more easily get access to this information if the individuals concerned assent to this. Furthermore, ICT can improve information on pension products and enhance the transparency of markets. In addition to more transparent information, better education may facilitate better individual decision making. Also new insights from behavioral economics may help. To illustrate, properly designed defaults based on information of individual features may assist individuals to tailor their pension arrangements to their specific circumstances.

Response to trends

In response to these trends pension systems have moved in the direction of accommodating more choice. Most pension systems now allow for a flexible choice of the retirement age with more or less actuarially fair adjustments. This applies to public, occupational, and individual schemes alike. Many European pension systems have reduced or eliminated altogether generous early retirement incentives introduced in the 1970-ties and the 1980-ties. Moreover, the tendency to limit the mandatory contribution rates in the face of the growing financial burden of pensions has increased the scope for individual choice in determining the ambition level of pension insurance. Furthermore, some countries have introduced flexibility in choice of provider (Chile, UK), flexibility in contribution rates (Kiwi Saver in New Zealand), and the portfolio mix with defaults (UK) With more financial risks being shifted to individuals in occupational schemes, some of these schemes may allow for more individual portfolio choice in the future, albeit with carefully designed defaults.

To contain individual failures, experiments with defaults (see Bodie and Prast, 2011) are increasingly popular in countries that traditionally heavily treasure individual discretion. Defaults maintain the freedom of individuals to opt out while at the same time addressing individual failures by assisting those who are not able or willing to choose themselves. To illustrate, the US introduced a pension law in 2006 that facilitates default enrollment in pension plans, automatic default escalation of pension contributions, and default portfolios (see Beshears *et al*., 2008).

Remaining challenges

Although empirical research shows that choice architecture has a powerful impact on actual choices, structuring choice in pension insurance in an optimal way is still in its infancy. Defaults

may take into account personal characteristics. However, defaults face similar problems as mandatory systems do. In particular, defaults cannot be tailored to individual features without pension agencies gathering information on individuals. Hence, also here privacy considerations limit the scope for tailoring pensions to the individual level, even though the cost of imperfectly tailoring pension contracts may be smaller than in mandatory systems because individuals can opt out. Furthermore, just as mandatory provisions, defaults raise governance and agency issues. How does one ensure that the agency setting the default settings acts in the interests of the pension consumers?

Whether pensions, which typically benefit from a favorable tax treatment compared to other type of savings, will be integrated more with other facilities for life cycle planning is unclear, and may depend on the pension model chosen. If governments force workers to participate in pension funds, they may not allow these mandatory pension funds to compete for supplementary financial services in order to not distort financial markets. Indeed, at present, pension insurance is often quite separate from other parts of life-cycle financial planning, such as housing finance and health insurance.

Financial intermediaries (including pension funds), however, can help individuals with their financial planning over the life cycle. In particular, they can advise workers in accumulating and insuring human and financial capital during their working lives. In this regard, disability and unemployment insurances are closely related to pension insurance. Indeed, the optimal retirement age depends on idiosyncratic health and labor-market risks, which tend to increase with age. Disability and unemployment insurances involve moral hazard; better insurance reduces the incentives to maintain human capital. Pension funds may help to find the optimal mix of saving and insurance. Moreover, integration of part of pension saving with precautionary saving for idiosyncratic human-capital risks may be optimal (see Stiglitz and Yun, 2002; Holzmann and Hinz, 2005).

During the retirement phase, the elderly need integrated advice with regards to housing, health care, the type of annuity (possibly of the escalating type) and, possibly, part-time labor income. Linking reverse life insurance through annuities to health-care insurance can combat selection; bad risks for an annuity company tend to be good risks for health insurers, and the other way around. Moreover, by providing health insurance, an insurance company reduces the need for liquidity, thereby making annuitization more attractive. Also in health and care insurance, moral hazard may be important, especially for relatively small risks such as personal services required around the home. For these risks, precautionary saving may thus be appropriate. This implies that annuities should be complemented by liquid private saving.

2.2 Intergenerational risk sharing

From a welfare point of view, risks should be shared as broadly as possible over various generations. Sharing current risks with future and young generations is especially valuable with habit formation[1] and volatile capital markets as a result of mispricing and bubbles. Two

[1] This applies both to external and internal habit formation. With internal habits, people are more risk-averse in the short run than in the long run because they need time to adjust their habits in response to shocks. With external habits, the pain of adverse shocks is softened if social reference groups share in these shocks.

fundamental constraints, however, limit intergenerational risk sharing. First, the limited liability of human capital (and the resulting non-tradability of human-capital risks) constrains the ability of young agents that have not yet accumulated financial collateral to voluntarily trade risks with older agents. Second, when younger cohorts start to trade on capital markets and can begin to conclude voluntary contracts, the older cohorts' life risks have been realized and are thus largely known. By that time, intergenerational risk sharing has become intergenerational redistribution. Generations do not voluntarily commit to a risk-sharing contract that involves risks that have already been realized; whereas young cohorts do not accept debts that older generations have run up in the face of adverse shocks, older cohorts do not transfer to younger generations the surpluses that these older cohorts have been able to accumulate in good times. Hence, in both good and bad times, intergenerational risk sharing may break down. This so-called discontinuity risk of the risk-sharing contract limits the credibility of sharing large risks across generations.

Institutions for intergenerational risk sharing

Private capital markets can help to share risks between generations who are close in age. To illustrate, by buying bonds, older agents may try to shift risk to younger generations who hold primarily equity claims. The limited liability of equity implies, however, that in case of large shocks bond holders will still be residual risk bearers. Private intergenerational risk sharing may occur also in rich dynasties that leave financial bequests.

As emphasized by Bohn (2010), some limited private risk sharing may occur also through private pension funds, which may alleviate the burden on the government in accomplishing intergenerational risk sharing. Bohn shows, however, that private risk sharing through occupational pension funds is feasible only if specific human capital or other factors (such as the limited portability of pension rights or implicit labor contracts involving deferred wages) tie workers to the insurance pool of the pension fund. Quasi rents that originate in specific human capital thus allow occupational pension funds to tax workers to some extent. Competition and mobility on the labor market, however, limit the tax power of occupational pension funds and therefore give rise to discontinuity risk as workers who are taxed heavily move to a different place of employment. Private and public risk sharing may be complements if the government either provides longevity and wage-linked bonds to private funds and insurance companies or engages in reinsurance of private pension schemes.

The government wields more tax power than pension funds because it controls the entire labor market of a country so that workers cannot escape taxation by moving to another sector or by becoming self employed. Taxes on labor income can include in risk-sharing arrangements also non-tradable human wealth of young generations who have little financial collateral. Even the government, however, is limited in its ability to commit generations to risk sharing because younger generations vote with their feet or their voice. In particular, if taxes are very high, agents avoid taxes by reducing labor supply in the formal sector or evade taxes by no longer declaring their labor income; the associated labor-market distortions limit the scope for intergenerational risk sharing.[2] Moreover, voters may not be willing to finance high government

[2] Bonenkamp and Westerhout (2010) find that these distortions are only small compared to the welfare gains of risk sharing. Mehlkopf (2010), in contrast, argues that the costs of risk sharing may be larger in current pension contracts.

debts. Anticipating the limited liability of the citizens of a country, financial markets constrain the ability of older generations to keep up their consumption level in the face of adverse shocks. The state suffers from other weaknesses as well. First, the government is subject to political risk. Second, and related to this, the state may have difficulty in taking a diversified portfolio of financial assets on its balance sheet. Indeed, political considerations may distort investment decisions if the state owns most firms in the economy.

Trade-offs: risk sharing versus limiting political risk, discontinuity risk and labor-market distortions

The fundamental trade-off bedeviling intergenerational risk-sharing is the trade-off between risk sharing and limiting political risk. Forcing workers to participate in intergenerational risk sharing reduces the discontinuity risk that young generations escape the risk sharing contract by voting with their feet. At the same time, however, lack of competition may give rise to political risks. In particular, older generations who wield the political power in a democracy may be tempted to abuse risk-sharing arrangements and shift risks onto younger and future generations without properly rewarding younger agents; incumbents grant themselves additional benefits in good times while they try to tax new entrants in bad times.

This trade-off between intergenerational risk sharing and containing political risk[3] thus involves market failure versus government failure; whereas markets cannot sustain voluntary risk sharing between generations that differ a lot in age, governments suffer from political risks as older generations that lack market discipline may abuse political power. The conflict between the economic power of workers who control their human capital, on the one hand, and the political power of older agents, on the other hand, complicates intergenerational risk sharing.

A related trade-off is between risk sharing and limiting discontinuity risk. Risk sharing involves ex-post redistribution, which threatens the continuity of the contract. Solvency regulations, for example, constrain intergenerational risk sharing but limit both political and discontinuity risk. Depending on the economic power of the young and the political power of the old, these regulations protect old or young cohorts. They protect younger generations by preventing older generations from shifting substantial unfunded liabilities onto the younger generations. If labor mobility is high or disincentives are important, these regulations limit discontinuity risk in the face of adverse shocks and thus protect the older generations.

This trade-off can also be stated as risk sharing versus labor-market efficiency.[4] In view of the limited liability of human capital, intergenerational risk sharing occurs through taxes on labor income, which distort the labor market. Accordingly, the price of intergenerational risk sharing is a less efficient labor market. Moreover, intergenerational risk sharing may require limiting the mobility of labor, for example by restricting the portability of pension rights across sectors. Also this may hurt the efficiency of the labor market.

Trends: aging, more labor mobility, more competition, and the financial crisis

3 A related trade-off is that between rules and discretion. Rules reduce political risks by limiting the discretionary powers of politicians but at the same time these rules constrain the flexibility of governments to respond to contingencies that were not anticipated when the rules were formulated.

4 See also the trade-off between insurance and incentive discussed in connection with intragenerational risk sharing below.

Various trends move the trade-off of risk sharing versus limiting discontinuity risk and labor-market distortions away from risk sharing. First of all, aging increases the weight of older compared to younger generations. In other words, the risk-bearing capital of younger agents is leveraged with more numerous older generations. This limits the scope for protecting older generations from risks by shifting risks onto future generations. To illustrate, aging of the membership of occupational pension funds has expanded the obligations of the funds compared to the premium base. Accordingly, unanticipated shocks in financial markets and longevity require larger changes in pension contributions in order to shield pension rights from these shocks. Guaranteed pension obligations have thus become more expensive in that these defined benefits result in more volatility in pension contributions. Also increased mobility of workers[5] and the reduced importance of firm-specific human capital move the trade-off between risk sharing and limiting discontinuity risk away from risk sharing because taxing workers in the event of a bad shock becomes more difficult.

Aging also affects corporate pension funds in which the residual claimants are primarily the shareholders of the corporation involved; for many corporations, financial and actuarial risks of pension guarantees start to dominate those of their core business. New accounting rules (FRS 17/IAS 19/FAS 87), which force corporations to disclose pension risks, make this increasingly transparent. The volatility of financial markets in the recent decade has also confronted corporations with the risks of corporate pension funds. At the same time, more intense competition implies that companies exhibit shorter lifespans and enjoy smaller rents. Moreover, increased debt finance has increased bankruptcy risk and has reduced the quality of the debt claims, including the pension obligations of the corporate pension funds. In the face of increased discontinuity risk and the limited liability of the shareholders, firms can thus offer less security to the participants of their occupational pensions. Retirees end up as residual risk bearers because companies often are in trouble when the pension fund is experiencing financial distress. In the recent financial crisis, for example, several corporations had to close their pension funds.

Response to trends: pension rights become risk bearing

As the capacity of sponsors, (future) workers and (future) tax payers to absorb pension risks has become more limited in the face of aging and increasing competition on commodity and labor markets, those who have accumulated pension claims become risk-bearing stakeholders and are thus confronted with more risks. Whereas traditional defined-benefit plans protect pension rights from financial-market and demographic risks, pension claims are increasingly being made contingent on shocks in longevity and on developments in financial markets. In other words, guaranteed debt claims have become risk-bearing capital. Also in the Netherlands, sectoral DB schemes are being transformed into hybrid systems, which explicitly put financial-market risk on those holding pension claims (both workers and retirees). In fact, risk-sharing contracts are becoming more complete in the sense that the pension contract is more explicit about who bears risks in case of unexpected macro-economic shocks.

Earnings-related PAYG systems also put more macro-economic risk on participants themselves, sometimes in an explicit fashion as in the NDC systems and sometimes in an

[5] The increased portability of pension rights aimed at a more efficient allocation of labor also enhances the mobility of labor.

implicit way as retirees share the pain of budget cuts if the public finances are hit by adverse shocks. In fact, PAYG schemes are becoming more explicit ex ante on how demographic and output shocks are allocated over various stakeholders to ensure the financial sustainability of the scheme, for example through automatic balancing mechanisms. Accordingly, not only in funded but also in PAYG schemes, the risk-sharing contract is becoming more complete in the face of a smaller base to absorb ever-larger macro-economic risks. Accordingly, defined-benefit systems that suggest that pension benefits can be shielded from macroeconomic risks are being replaced by pension systems that put these shocks on the participants in a predictable manner. Individual property rights on risky assets are clarified by separating the public pension system from the rest of the budget. This shift away from discretion to predictable rules reduces political risks.

Response to demographic changes

Aging is the result of increased longevity and lower fertility. Increasing life expectancy challenges both funded and PAYG systems; at a given retirement age, it increases the length of the retirement period that needs to be financed. More and more pension systems are explicitly shifting the costs of higher longevity onto the participants of the pension plan – at least during the accumulation phase. Hence, workers have to delay their retirement if they want to maintain their standard of living in retirement in the face of increased longevity. This may not be problematic if lower mortality goes together with lower morbidity and people can maintain their labor productivity up to an advanced age. Indeed, whether increased longevity leads to lower consumption level depends on whether human capital rises at a slower speed than the life span.

As regards fertility risk, especially PAYG schemes seem to be vulnerable to lower fertility because PAYG schemes rely on human capital of the young to finance the pensions of older generations. Indeed, in the face of lower fertility, funded pensions may replace part of the PAYG pensions as cohorts that raise fewer children rely more on financial capital than on investments in the human capital of children to safeguard their retirement incomes (see Sinn, 2000). However, as global aging may reduce rates of returns on capital markets, also funded schemes may come under pressure as a result of lower fertility. Indeed, aging is likely to increase the return on human capital and reduce the return on financial saving. Hence, lower fertility may result in more labor supply per capita and more investment in the quality of human capital rather than in more saving.

In response to the growing burden of ageing, many countries have cut back the cost of pensions in an attempt to put a ceiling on pension contributions. In line with DC schemes, most of the burden of adjustment is thus put on the benefit side by raising the retirement age, restricting the eligibility for benefits in other ways, or reducing replacement rates. Some countries with large PAYG systems have limited the indexation of benefits in payment. This may facilitate a move towards a multi-pillar scheme, which includes not only a public PAYG scheme but also occupational pension plans and personal pension schemes (see European Commission, 2010, 365/3, Figure 10).[6]

Remaining challenges

[6] See European Commission, 'Towards adequate, sustainable and safe European pension systems,' Green paper COM (2010) 365/3, Figure 10.

The primary remaining challenge concerns the optimal sharing of labor-market and financial-market risks across generations. PAYG systems typically link pension rights to wages (most NDC systems), while pension rights in funded systems typically depend on financial-market risks. A more optimal pension system would implement optimal life-cycle investment. In particular, the government, which taxes labor income, would provide wage-linked retirement benefits to older generations so that wage risks are shifted away from workers to pensioners, who are then protected against standard-of-living risk. Alternatively, the government could issue wage-linked bonds, which pension funds and insurance companies can buy to hedge wage-linked retirement benefits. At the same time, workers would absorb financial-market risk by holding equity in their own retirement accounts. Moreover, the government can take financial-market risks on its balance sheet on behalf of younger generations with non-tradable human capital (*e.g*. through taxes on capital income and consumption). There is no unique solution this challenges; different pension systems can take different routes. We return to this in Section 4 below.

Important demographic risks are aggregate mortality and morbidity risk. In the optimal pension system, the tail mortality risk (*i.e*. the survival probabilities at very advanced ages) should be absorbed by younger generations rather than by the cohorts concerned. This in effect amounts to a defined-benefit aspect in the pension system: younger generations insure the macro longevity risk of the oldest generations. One way to implement this in the face of the limited liability and non-tradability of human capital is for the government to issue longevity bonds for these tail risks while at the same time reducing its longevity risk by not allowing the public pension claims of younger cohorts to rise with longevity. In this way, both the government and the private sector are involved in providing pension insurance.

With participants of funded schemes bearing more financial-market risks, private pension funds must find optimal ways to allocate risk over the participants,[7] to communicate this risk, and to help participants absorb the risk. To illustrate, current Dutch occupational pension plans impose uniform investments and indexation rules on all participants but are currently investigating whether indexation rules can be differentiated across age groups. Workers can then take more risks on their pension savings and benefit from the associated risk premiums, whereas the contract for the retirees is geared primarily towards protection of the purchasing power of the pension entitlements (see, *e.g*. Munsters *et al*.,2008). These reforms can be complemented by more flexibility in contribution rates. In fact, flexible contribution rates allow workers to bear more financial risks and thus to benefit more from the rewards of risk taking. Indeed, after an expected shock, it is optimal to adjust consumption levels during the rest of one's lifetime and not only during retirement. Hence, both premium levels and benefit levels should respond to risks, although habit formation may dictate smaller adjustments in the short run than in the long run.

There are other challenges as well. Due to the longevity adjustments, many countries project substantial declines in the replacement rates at the fixed retirement age over the coming decades. These declines help to ensure fiscal sustainability in the face of an aging population. However, these cuts in replacement rates are credible only if older workers remain more productive and are able to continue to find work beyond current effective retirement ages. If

[7] This involves also the function of life-cycle planning and the associated individual failures. Individuals are typically not able to select optimal portfolios during the life cycle.

these labor-market conditions are not met, governments will face political pressures to raise replacement rates so that the living standard of the older population does not decline too far below that of the rest of the population. Indeed, intertemporal consumption smoothing then demands higher pension contributions. Alternatively, the public finances will be burdened by higher costs of other social insurance programs, such as the disability insurance, unemployment insurance or means-tested guaranteed pensions. Financial sustainability therefore depends on whether human capital of older citizens can be protected and utilized better. Only if lower mortality goes together with more durable earning power are stable contribution rates credible in the face of increased longevity.

2.3 Intragenerational risk sharing

Before they know which idiosyncratic shocks they will be subject to, agents can voluntarily pool risks in insurance markets. In some cases, however, agents feature private information about their risk features. Agents who know that they have a low probability of suffering damages will then not voluntarily pool risks because insurance premia are based on the average risk features of the population as a whole. This phenomenon, which originates in private information about one's risk features when one first can take out insurance,[8] is called adverse selection and destroys voluntary insurance markets. More generally, after uncertainty is resolved and agents know their type, intragenerational risk sharing becomes redistribution: some agents must transfer resources to other agents. If agents have not been able to sign an insurance contract behind the veil of ignorance about their type, this transfer of resources will not occur voluntarily.

Institutions for intragenerational risk sharing and redistribution

By making risk sharing compulsory, the government in effect redistributes resources from the good risks to the bad risks. More generally, after uncertainty is resolved and insurance has become redistribution, the state has to force the lucky agents to give up resources. Indeed, the state has a leading role in facilitating intragenerational distribution. The state has the monopoly power to tax because democratic control provides the legitimacy to intervene in private property rights.

Private insurance schemes controlling a group of workers may also fight selection and implement some limited redistribution. If workers feature specific human capital in specific sectors, for example, pension schemes that cover the entire industry may be able to pool workers facing different risk levels. However, competition and mobility on labor markets limit the scope for compulsory pooling of workers who exhibit different risk levels. To illustrate, if some workers pay contributions that exceed an actuarially neutral level, the employers involved may have to pay higher wages to attract these workers.

[8] Just as the function of life-cycle planning, the function of intragenerational risk sharing is complicated by asymmetric, private information about an individual's idiosyncratic features. Just like intergenerational risk sharing, intragenerational risk sharing becomes more complicated and does not occur through voluntary market transactions if agents cannot sign insurance contracts when they are still ignorant about their risk features.

Government regulation and private risk pooling are complements if government regulation forces workers with specific human capital in a particular sector to pool their risks in a single pension scheme. Moreover, private pension funds can help to redistribute if the government regulation ensures that individuals cannot escape the redistribution by moving to a different place of employment. To illustrate, regulation that forces financial institutions to charge the same price for annuities to both genders may be able to redistribute from males to females.

Trade-off in longevity insurance: combating selection versus accommodating heterogeneity
Forcing people to pool their risk prevents them from selecting their own level of insurance. This gives rise to a trade-off between combating selection and accommodating individual heterogeneity. To illustrate, some people may not want to take out longevity insurance through forced annuitization because they prefer to keep their wealth liquid during retirement in the face of either idiosyncratic risks or spending preferences that differ from the average preferences.

Another illustration of this trade-off involves the choice of the age at which one wants to start receiving an annuity. Offering people more discretion to select this age on the basis of uniform actuarial adjustments results in selection as short-lived agents choose to retire early while long-lived agents are better off retiring later.

Combating selection in longevity insurance also yields a trade-off between efficiency and equity. In regular social insurance, compulsory insurance benefits both equity and efficiency as it protects the bad risks, which tend to be the persons with little human capital. In pension insurance, however, the bad risks are long-lived agents, who tend to have substantial human capital as well. Accordingly, by forcing people to take out pensions, the government helps to create efficient longevity insurance but at the cost of perverse solidarity between short-lived vulnerable agents and long-lived richer agents.

Trade-off in human-capital insurance: insurance versus incentives
Another trade-off affects the insurance of idiosyncratic human-capital risks such as disability, health problems and unemployment: the better people are insured against loss in human capital and the associated decline in labor productivity, the fewer incentives they face to prevent this loss. This trade-off between insurance and incentives is closely related to the trade-off between equity and efficiency: more redistribution by providing more income to those with less human capital and less labor income harm the incentive to work and to accumulate skills.

The trade-off between insurance and incentives applies to the design of retirement incentives. Older workers who suffer from idiosyncratic health shocks affecting their labor productivity want to retire early. Providing generous early retirement benefits thus helps to insure these adverse human-capital shocks. At the same time, however, such benefits erode labor-supply incentives and the incentives to treasure human capital. In other words, making retirement benefits more actuarially neutral by compensating workers for delaying retirement serves labor-supply incentives but removes the insurance of human-capital shocks at the end of the working life. Adverse labor-supply incentives associated with human-capital insurance can be mitigated by providing benefits only on the basis of verifiable health problems. However, disability and pension insurance often cannot be separated because health shocks and the impact on labor productivity are not verifiable.

The insurance-incentives trade-off is quite relevant in the last part of the working life. On the one hand, people face more idiosyncratic productivity risk at the end of the working life due

to loss of specific human capital or the accumulation of adverse health shocks. On the other hand, retirement decisions are quite sensitive to incentives, thereby raising the efficiency costs of policies that protect those who have to retire early due to non-verifiable health and ability shocks.

A related insurance-incentives trade-off involves the commitment of the government not to let older agents starve. This implicit public insurance discourages agents from saving. If the government combats moral hazard in saving by forcing workers to save out of their labor income, it discourages labor supply. The better the government thus insures its citizens against old-age poverty through means-tested programs, the more saving and labor supply are discouraged.

Trends: more heterogeneity and more moral hazard

Trends complicate the insurance-incentives trade-off by both raising the need for insurance and increasing the efficiency costs of insurance. As regards the benefits from insurance, heterogeneity among older workers increases due to growing cultural and economic diversity. To illustrate, the gaps in mortality, morbidity and health between various workers is growing. Moreover, along with increased competition, insurance in implicit labor contracts is decreasing, thereby raising idiosyncratic human-capital risk. A more dynamic world economy and a decline of the extended family as an insurance device have increased the demand for such insurance as people experience more substantial economic insecurity.

As regards the costs of insurance, various developments increase the dangers of moral hazard and hence make insurance of human-capital risks more costly. As the economy shifts from blue-collar work in industrial sectors to white-collar work in service sectors and knowledge-intensive activities, mental causes of sickness and disability become more prominent. These types of sickness and disability can be less easily verified than physical disabilities. Moreover, more heterogeneity of work patterns in general and at the end of the working life in particular make it more difficult to separate voluntary periods of inactivity from involuntary unemployment. Retirement decisions, for example, are becoming more flexible now that mandatory retirement and pension systems with fixed retirement ages are being phased out.

At the same time, individuals can increasingly affect the probability that they become unemployed by investing in their own employability. In other words, the dividing line blurs between the contingencies that people are responsible for and those for which they are not. These changes in the nature of social risks make it more costly to insure human capital in terms of harming the incentives to accumulate and maintain that capital.

Another reason why redistribution has become more distortionary is that age is no longer a good indicator of poverty, because many elderly individuals have accumulated substantial financial wealth. Hence, information on age should increasingly be supplemented by other information (in particular on incomes and family status) to identify those most in need of income support. This increases the efficiency costs of redistribution because individuals can affect this information (in contrast to information about age) by changing their behavior. Another aspect of intragenerational redistribution is that between genders. In many countries, the labor-market position of women has strengthened, which reduces the burden on pension systems to provide generous survivor benefits. At the same time, however, family structures have typically become less stable. The associated higher risk of divorce has put many women at risk, thereby increasing the pressure on redistributive programs.

Response to trends

To reduce labor-market distortions, occupational pension systems and earnings-related PAYG systems have become more actuarially fair. In particular, many countries have improved incentives for later retirement by raising actuarial adjustments for later retirement. Moreover, several countries have at the same time tightened eligibility criteria for unemployment and disability schemes in order to prevent these schemes from being abused as early retirement programs. In particular, the duration of unemployment benefits has been shortened and disability benefits are granted only for verifiable losses in earnings capacity. More generally, disability programs are more and more separated from old-age pension programs. Indeed, as longevity increases, the purposes of disability insurance and retirement insurance are increasingly distinct.

Earnings-related pension schemes have improved labor-market incentives during the working life by linking benefits more tightly to contributions during the entire working life. In occupational pension schemes, for example, final-pay schemes (in which benefits are based on wages in the last years before retirement) have been replaced by career-average schemes so that pension rights are based on earnings during the entire life cycle. Moreover, in contrast to many older Bismarckian earnings-related PAYG schemes, NDC systems link benefits more tightly to contributions during the life cycle.[9] Improved ICT systems facilitate the registration of the entire labor-market history. The function of redistribution and poverty alleviation is separated from the earning-related pension system and put in a separate zero pillar (see Hinz, 2010).

In view of a more heterogeneous older population, some countries are replacing generic tax privileges for the elderly by means-tested tax benefits. Indeed, as age is no longer a good indicator of poverty, tax privileges should be based on not only age but also income and wealth.

Remaining challenges

In setting retirement incentives, pension systems as a whole do not escape the fundamental trade-off between insurance and incentives that is the result of substantial heterogeneity at the end of the working life. In particular, more actuarially neutral pension pillars that are aimed at consumption smoothing during the life cycle are typically supplemented with special provisions for low-income groups in order to avoid old-age poverty. Helping groups with low human capital escape old-age poverty inevitably harms the incentives to accumulate, maintain and utilize human capital. To illustrate, means-tested pensions impose a marginal tax rate on labor income for those who benefit from these pensions. Moreover, disability and unemployment insurance programs inevitably give rise to moral hazard as a result of human-capital insurance.

Compared to other workers, workers with low earnings typically face substantially smaller incentives to delay retirement for at least two reasons. First of all, various means-tested programs discourage low-skilled workers from continuing to work because additional labor income is taxed away in the form of lower means-tested benefits. Second, actuarial adjustments of pension benefits are based on average mortality rates, while low-skilled workers generally

[9] Despite the stronger link between contributions and benefits, mandatory earnings-related schemes still imply an implicit tax on workers if these workers are myopic. In that case, workers discount the value of the additional retirements that are being accumulated. Accordingly, forced saving may help to address saving distortions, but at the same time introduce labor-supply distortions.

feature higher mortality rates and lower life expectancy. Low-skilled workers are thus not compensated adequately for later retirement and thus face incentives to start receiving retirement benefits as early as possible.

An important challenge in this respect is whether countries succeed in addressing the labor-market challenges of low-skilled and high-skilled workers alike. The less countries succeed in raising the earning powers of low-skilled workers in line with those of high-skilled workers, the more they will be forced to have additional means-tested defined-benefit social programs for low-skilled workers whose human capital depreciates earlier in life. These programs typically harm incentives to maintain human capital, increasing the likelihood of a vicious circle is likely in which human capital does not become more durable. Accordingly, the main challenge for aging economies in which longevity increases is to address the weak labor-market position of elderly workers in general and that of vulnerable older low-skilled workers in particular.[10]

Individual saving accounts can improve the trade-off between insurance and incentives by facilitating self-insurance over the life course. For each type of human capital risk, another combination between insurance and precautionary saving is optimal. Stiglitz and Yun (2002) show that saving should play a more prominent role if risk aversion is low, moral hazard is important, various risks are uncorrelated across time and among each other, and these risks are only small in a lifetime perspective. They also demonstrate that the optimal extent to which agents use precautionary saving to buffer shocks depends on the history of an individual. Self-insurance should optimally be the most important for those individuals who have not experienced adverse shocks early in life so that they are not likely to end up being lifetime poor. Saving schemes thus can play a more important role in enhancing incentives for the middle- and higher incomes than for the lifetime poor.

2.4 Conclusions

We identified similar tendencies in all pension systems, irrespective of whether they are mainly state oriented and PAYG or more privately oriented and funded. One could even speak of convergence in many important respects as distinct pension systems respond to the same trends by reforming pension contracts in similar ways. As regards tailoring to heterogeneity in life-cycle planning, pension systems accommodate more individual choice but at the same time more carefully structure the choice architecture, for example through defaults. As far as intergenerational risk sharing is concerned, more pension systems determine ex ante how major macro-economic risks (wage and employment risks, demographic risks, financial-market risks) will be allocated over the various stakeholders. In the resulting risk-sharing contracts, more macro-economic risks are put unto pension rights and pension benefits instead of pension contributions in view of the limited liability of the sponsors of the pension schemes. Also retirement ages have been raised and made more flexible, early retirement benefits have become more actuarially fair, and pension benefits are linked more tightly to life-time contributions in an attempt to make pensions and their financing more transparent and less distortionary. Other

10 Similar issues arise for women. The more countries succeed in strengthening the labor-market position of women, the less they have to rely on social programs that protect women (*e.g.* partner pensions) but that at the same time harm labor-market incentives faced by women.

functions, such as redistribution and poverty alleviation, have been moved outside of earnings-related pension systems to the tax and welfare system or social insurance (*e.g.* disability and unemployment insurance).

These similar responses to common trends faced by all retirement systems do not mean that all systems can be expected to evolve toward one unique 'optimal' system, for two reasons. First, underlying the design of the pension system are fundamental trade-offs, with countries taking different positions on these trade-offs. Second, the institutional design of a particular position on the trade-off has no unique solution. The same functions can be performed by alternative institutions. Which institutions fit best in a particular country depend on the country's specific circumstances and history.

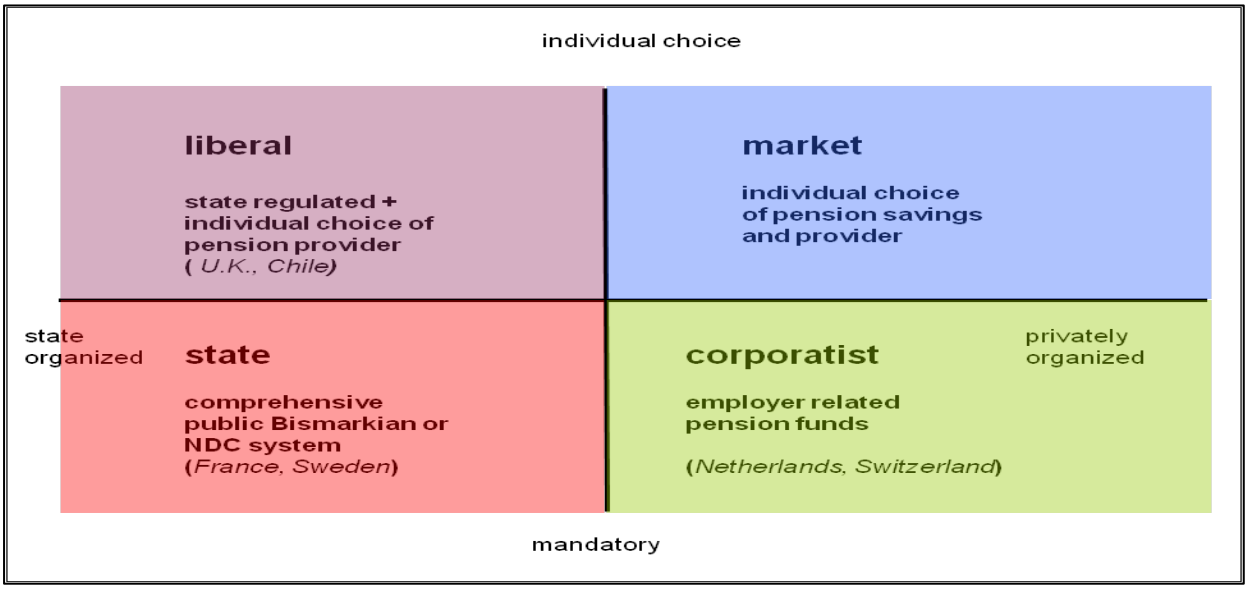
The transformation of pension systems in response to trends is underway but is by no means finished. We have identified a number of challenges for future reforms. The next section will turn to the normative question how the pension system under alternative institutional designs should ideally develop in the future.

3 Alternative pension systems

Pension systems can be organized in different ways. Each system performs the same functions and faces the same challenges that were identified in Section 2. Nevertheless, important differences remain between countries with regard to the organization of the pension system, depending on the specific history and institutions in a particular country. These differences involve especially the earnings-related part of the pensions. We therefore develop a typology of earnings-related pension systems. This typology is based on two dimensions (see Figure 1).

The first dimension involves the governance of pensions. Does the state administer and control earnings-related pensions or are these responsibilities left to the private sector through group insurance (occupational pension plans) or individual decisions (personal pension plans)? As pure public and private systems do not exist, we will rather speak of state-oriented and private-oriented systems. Indeed, government versus private control has various dimensions. For example, the government can mandate individuals to take out pension insurance from a specific insurance pool, which is administered privately (*e.g.* sectoral pension funds). Alternatively, the state can provide the longevity insurance but contract out certain tasks (administration, investment) to private parties. Yet another possibility is that private insurance companies provide voluntary pensions but that the government provides financial instruments to allow private parties to hedge important macro-economic risks (such as (wage) inflation risk and longevity). This illustrates that the various tasks involved in earnings-related pension insurance (administration, investment, insurance, intergenerational and intragenerational risk sharing, marketing, assisting individuals in complicated life-cycle financial planning) can be distributed in alternative ways over the government and the private sector.

Figure 1 Typology of pension systems



The second dimension distinguished in our typology involves the scope for individual choice in pension insurance. Also here, we speak of choice-oriented and mandatory-oriented systems because the extent of choice is multi-dimensional as well. Indeed, choice has more aspects than mandatory versus voluntary participation in pension insurance. In particular, during the working life, individuals may be able to select the level of the contributions, the investment portfolio or the sensitivity of the accumulated pension rights to macroeconomic risks, the extent and type of survivor and other insurances (*e.g.* disability insurance), the insurance pool, the provider and the retirement age (*i.e.* the age at which pension income is received for the first time). At or during retirement, they may choose the type of annuity (unit-linked, linked to price or wage, or lump-sum payments), additional insurances (*e.g.* health or care insurance), and the insurance company or the insurance pool. Finally, in addition to individual choice, employer choice is an issue. For example, are employers free to select their own insurance pool and insurance company or pension fund for their workers?

The typology of earnings related-pensions in Figure 1 leads to four prototype models. The classical juxtaposition is that between, on the one hand, a mandatory state system (in the southwest corner of Figure 1) and, on the other hand, a market-based system with free choice of savings and insurance in private capital markets (in the northeast corner of Figure 1). The typology distinguishes also two more hybrid systems: a corporatist system with mandatory participation in private pension funds (in the southeast corner of Figure 1) and a liberal system, which leaves scope for individual choice in publicly regulated systems (in the northwest corner of Figure 1). The Dutch and Swiss pension systems with an important role for employer-provided earnings-related pensions provide an example of the corporatist system. The Chilean system with mandatory pension savings together with free individual choice between private pension funds and insurance companies is an example of the liberal system. Also the pension

reforms on the 'second state pension' in the UK with automatic enrolment with the option of opting out can be viewed as an example of a liberal system.

These prototypes bear some resemblance to the classification of the welfare state by Esping Anderson (1990), who distinguishes the Scandinavian, Anglo-Saxon, and Corporatist systems. The three prototypes of state, market and corporatist correspond more or less to the Scandinavian, the Anglo-Saxon and the Corporatist models, respectively. Figure 1 associates these systems with the colors of red, blue and green. Our fourth prototype -- the liberal system -- relies on extensive government regulation but leaves ample scope for individual choice and market competition. As a mixture of the state (*i.e.* red) and the market model (blue), Figure 1 assigns the color purple to this prototype.

The World Bank (see Holmann and Hinz, 2005) distinguishes three pillars in earnings-related contributory pensions.[11] The first pillar is a publicly managed and mandated pension plan. The second pillar involves mandatory, private pension plans. Voluntary private plans make up the third pillar. The first dimension of our typology – state versus private systems– thus involves the distinction between the first public pillar, on the one hand, and the private second and third pillars, on the other hand. The second dimension – individual choice versus mandated systems – relates to the border-line between the mandatory first and second pillars, on the one hand, and the voluntary third pillar, on the other hand. In our typology in Figure 1, the first pillar is the dominant form of pension provision in the state model while in the market model the third pillar is dominant. With regard to the second pillar, our typology distinguishes between two alternatives: first, the traditional corporatist model in which participation is mandatory and linked to the employer or industry through occupational pension plans controlled by corporations and possibly representatives of workers and, second, the liberal model in which the government determines the pension contract and enforces participation but at the same time leaves the administration, investment and insurance to private-sector parties. The second model creates scope for individual choice and competition in the market for personal pension plans.
These four prototypes can be filled in more in detail as follows.

State model

The classical state is associated with the traditional welfare state that provides social insurance for its citizens from cradle to grave. The pension system is controlled and administered by the state and is comprehensive and largely mandatory. The state organizes not only the basic pension aimed at poverty alleviation but also earnings-related pensions for the middle class. Most households thus do not need to save voluntarily for their retirement income. Not only the function of life-cycle planning but also that of intergenerational risk sharing is conducted by the government. Intergenerational risk sharing sometimes relies on separate rules such as automatic balancing in NDC systems but can also be integrated with the rest of the public finance, including public-debt policy. Funding of future pension liabilities is ensured through fiscal

[11] In addition, the World Bank identifies a basic pension (the so-called 'zero' pillar) aimed at poverty alleviation and a fourth pillar involving informal family support, formal social programs for the elderly (*e.g.* health care insurance and social housing), and individual assets (including homeownership). These two pillars are not directly related to earnings.

policy aiming at debt reduction or building up some reserve fund within the government (Norway, Sweden).

These state systems are typically mandatory, but may leave some scope for individual choice, for example regarding the retirement age. However, this scope is limited in order to avoid adverse selection in insurance and individual failures in life-cycle planning. This prototype encompasses both the classical Bismarckian systems (in Germany and France for example) and the more modern NDC systems (in Sweden and Norway, for example).

Market model

Earnings-related pensions are the responsibility of the private sector through either employer-provided plans or individual pension plans. Participation in pension savings is voluntary, or can be part of the labour contract of individual employers. The state provides a basic flat social pension to avoid poverty in old age. The government also regulates the private sector. Solvency regulation ensures that the promises of pension funds and insurance companies are credible. Moreover, regulation helps to make financial markets more transparent for individual consumers. Individuals are not forced to participate in mandatory earnings-related plans, can take their own portfolio decisions and are free to take out their retirement capital as a lump sum rather than an annuity. The government may encourage pension savings or annuitization by using subsidies and tax benefits.

In the Esping-Anderson terminology, the Anglo Saxon welfare state conforms to the market model. With respect to pensions, however, the state in the main Anglo Saxon countries – the UK and the US – plays an important role in providing earnings-related pensions. Moreover, over and above these public systems, these countries are starting to employ defaults to guide individual decisions and stimulate privately provided pensions to supplement their public systems. The planned reforms in the UK, for example, move this country further towards the liberal model.

Corporatist model

In the corporatist prototype, pension funds organize earnings-related pension insurance for workers of specific firms or sectors. Earnings-related pensions are considered to be part of the labor contract. Pensions are thus employment-related and provided by the employer. Pension funds are organized on a occupational or sectoral basis, for example, as collective DC of DB systems or as mutual insurance companies. As cooperatives, pension funds are typically governed by representatives of the employers and the unions, which play an important role in corporatist countries. Together with the basic pension provided by the state, the system is comprehensive and mandatory, leaving little scope for individual choice in terms of the level of saving or the portfolio choices. Typical examples are the Dutch and Swiss pension systems. The government may support the private pension funds by providing tax advantages and enforcing mandatory pooling of individual firms and their workers in industry-wide pension funds.

Liberal model

Just like the corporatist solution, this prototype aims to synthesize the state model and the market model. But rather than relying on employer-provided pensions negotiated between social partners, it combines state regulation with individual responsibility. The state both organizes the basic pension and controls earnings-related pensions, but leaves room for private administration

and insurance as well as individual choices. In particular, the government can mandate earnings-related pensions by forcing workers to enroll in personal pension plans, while leaving workers free to select their own investment and insurance companies. Individuals are thus not constrained by agreements between unions and employers. The Chilean system is an example of this model.

Rather than forcing people to enroll, a more liberal version of this prototype model is to automatically enroll workers while giving them the discretion to opt out of earnings-related pension insurance. This model thus takes to heart the lessons of behavioral economics and can be characterized as 'libertarian paternalism' as distinct from 'old paternalism' and the associated mandatory systems. An example is New Zealand's Kiwi Saver plan, which combines automatic enrollment with some degree of individual choice of contribution rate (within some range), including the option to take contribution holidays and withdraw capital before the retirement age under special circumstances. People can opt to save also through mortgage repayment rather than a pension plan. Another interesting case is the UK where the State Second Pension (S2P) allows for contracting out with a employer-based occupational pension. From 2012 on, a new system of centrally administered personal accounts is being introduced, the so-called National Employment Savings Trust. Enrolment will be automatic for all employees, who are not enrolled in a suitable occupational pension, but opting out or making additional contributions are possible.

4 Optimizing the four pension models

Significant further improvements are possible within each of the four models identified in Section 3. This section focuses on two major issues: first, how each of the systems can improve upon intergenerational risk sharing (Subsections 4.1 to 4.3), and second, how each system should balance the increasing need to tailor individual arrangements to individual heterogeneity with the desire to combat adverse selection and to combat individual foibles in life-cycle planning (Section 4).

4.1 Intergenerational risk sharing

We distinguish human capital of current generations H, human capital of unborn generations U, and financial capital F, which matches physical capital and may consist of equity and debt. Total wealth W is the sum of these three wealth components. We focus on macroeconomic risks related to financial and human capital, and for the moment neglect demographic risks. Under the assumption of CRRA preferences, optimal risk sharing requires that each agent i holds a portfolio in which the share of each asset corresponds to the aggregate fraction of that asset. This could be taken as a starting point for the optimal distribution of macroeconomic risks across generations. [12] We thus have in the optimum

[12] With habit formation, older generations will want to take less risk than younger and future generations. Mean-reversion in stocks works in the same direction. Labor-supply incentives related to the limited liability of human capital, however, is an argument for absorbing risks in the short term rather than the longer term (see Mehlkopf,

$$W_{it} = H_{it} + U_{it} + F_{it},$$

$$\frac{H_{it}}{W_{it}} = \frac{H_t}{W_t} = h_t,\ \frac{U_{it}}{W_{it}} = \frac{U_t}{W_t} = u_t,\ \frac{F_{it}}{W_{it}} = \frac{F_t}{W_t} = f_t.$$

For reasonable values of growth corrected interest rates (1.5%) – uniform for human capital and physical capital – and a steady population, the fractions h_t, u_t and f_t, are about 20%, 65% and 15%. The fraction of financial capital in total wealth equals 15%, which is in line with the observed share of capital income (net of depreciation and investment) in total income. Of human capital less than a quarter is held by current generations in their working age (20 to 65) while the largest part belongs to future generations. These figures correspond to actual data found for the Netherlands.[13] For example, total financial wealth including housing and net claims on the government amounts to some 550% of GDP in the year 2009. Human capital can be estimated at some 3000% of GDP, in accordance with the 85 – 15 division between human wealth and financial wealth. Optimal risk sharing requires that shocks in each asset are smoothed among all individuals. For example, a relative drop in the value of financial assets of 1 % should cut individual consumption levels by no more than 0.15% if human capital is unaffected. We measure shocks in terms of stocks of wealth rather than momentary flows of income because we focus on permanent shocks only.[14]

Human capital and financial capital are aggregates that are subject to different underlying risk factors. Whereas they may be subject to similar underlying risk factors (such as productivity risk), human and financial capital are also subject to some uncorrelated risks. For example, human capital may be subject to – labour augmenting – productivity shocks, while physical capital faces depreciation and valuation risk. Also the time frame may differ across asset categories: financial assets generally feature a longer time horizon than human capital of current generations (*H*), but a shorter duration than human capital of future generations (*U*).

Risk sharing and the size of pension pillars

An important implication of our normative analysis is that pension wealth of retirees who have depreciated their human capital should be exposed to financial risks for only 15 % and to human-capital risks for 85 %. Human capital here includes human capital of future generations. If wages follow a random walk, all shocks are permanent so that current and future human capital are subject to the same shocks. Indexing pensions to current wages then ensures optimal risk sharing. If the process of wages is more complex, pensions should be linked to the

2010). Similarly, if financial shocks are cointegrated with wage shocks, current generations may want to absorb a large share of the current financial shocks as they are over time absorbed by younger generations through their human capital.

[13] Calculated on the basis of long-term projections in Van der Horst *et al.* (2010).

[14] If temporary shocks can be smoothed over time, they exert only a negligible impact on welfare. Intertemporal smoothing is a reasonable assumption for owners of financial capital, but may be disputable for younger households facing borrowing constraints. This could be an argument for state-dependent taxation conditional on flow rather than stocks. In particular, tax rates can be reduced in bad states when wages are low and increased when wages are high.

permanent component of wage shocks. Hence, current shocks are smoothed and current pensions depend also on current news about future wages.

This optimal pension contract for retirees is hard to realize through tradable financial assets only because financial markets typically do not trade claims on current and future human capital. Markets in wage-linked bonds would be an adequate substitute, but also these markets do not yet exist and will probably require government intervention in light of the limited liability of human capital. In the absence of wage-linked assets, tradable financial claims can take care of only 15 % of total pension income, namely the part corresponding to physical capital. The government or pension funds should take care of the remaining 85 % of the retirees' pension portfolio, which should be related to human capital. This could take the form of pension payments indexed to wages. The pension funds could match these wage-linked promises by buying wage-linked bonds issued by the government. Alternatively, occupational pension funds can promise wage-linked benefits to retirees if they can tax workers who earn quasi rents in the insurance pool covered by the pension fund.

Our model of intergenerational risk sharing thus yields a normative theory about the optimal share of wage-linked pension benefits, which can consist of non-tradable PAYG pensions and wage-linked private pensions on the basis of tradable wage-linked debt issued by the governments (or derivatives thereof). Aging of the population decreases the portfolio share of human capital in total wealth so that the optimal share of wage-linked assets declines. Aging should thus result in a larger exposure to financial risks and a smaller exposure to human capital risk in retirement.

Taking account of risk sharing through the tax system

In determining the optimal size of the pension pillars, one should take account of the redistribution of risks already present in the tax system. By taxing wages of the young to finance wage-linked pensions for the old, the government shifts human capital risks from workers (*i.e.* the young) to retirees (*i.e.* the old). Taxing capital or capital income (including taxes on bequests,[15] imputed rents from owner-occupied housing and property) redistributes risks in the opposite direction, *i.e.*, from the old to the young. How the tax system affects the distribution of risks across generations depends on the tax and transfer system and the way taxes and transfers are changed if shocks hit the government budget. Precise analysis of intergenerational risk sharing through the public sector is beyond the scope of this paper, but that it can be substantial is evident from the contribution of Bettendorf and Knaap (2011) and related studies by Bohn (2009).

One important aspect that deserves attention, however, concerns the taxation of private pension savings. In the absence of public pensions, optimal risk sharing would require a capital income tax on life-cycle saving of retirees equal to the share of human wealth in aggregate wealth $(H+U)/W$. According to our benchmark, this would amount to a tax rate on life-cycle savings of no less than 85%. Such a high tax rate on life-cycle saving is clearly out of the question. Yet, in the case of a cash flow treatment (EET) of private pension savings and consumption taxation (such as VAT) actual tax rates may come close, even without causing

15 Bequests shift capital-market risks from the older to the younger generations. Taxing these bequests helps to spread these risks over a larger population rather than focus these risks on the relatively small group of agents that benefits from large bequests. Taxation of bequests thus facilitates intragenerational rather than intergenerational risk sharing.

overly large distortions in pension savings (see Bovenberg and van Ewijk 2011). Another way in which the government can insure capital-market risks on pension saving is by providing a minimum guarantee, as is the case in the US. Alternatively, the tax rate on pensions can depend on the rate of return. In particular, by offering a tax reduction if returns are low and raising tax rates if returns are high, the government mitigates the downward risks of private savings.

If financial wealth is concentrated in the hands of very wealthy individuals, this may also mitigate the problem of inadequate intergenerational sharing of financial risk in a market system. Most of the wealthy may be expected to leave intentional bequests. The size of these bequests varies with financial shocks so that future generations owning human capital bear financial risks. In other words, these dynasties own both human capital and financial capital and can engage in optimal risk sharing between various members of such a dynasty.

4.2 Risk sharing in the four alternative systems

How risk sharing is organized depends on the pension system. We consider each of the alternative systems distinguished in the typology of Figure 1. Table 2 summarizes the results with regard to the magnitudes of the pension pillars distinguished by the World Bank. We start with the market model and the liberal model and then turn to the more complex cases of the state model and the corporatist model.

Market model

In the market model, individual savings in financial markets are typically invested in tradable financial assets representing physical capital, while the basic PAYG pension provided by the state (zero pillar) takes care of the human capital exposure of retirees. Optimal risk sharing would then require PAYG pensions representing 85% of total pensions, which is quite substantial. To illustrate, in the Netherlands, the basic public pension (AOW) currently represents about 50% of total pension income but this figure is declining due to population ageing and the maturing of funded pensions. A rough indication of the desirable size of the zero pillar can be derived from the difference between the social minimum (as a measure of the poverty line) and average wage income. In Europe, average wage income is about three times larger than the income of the poorest 10% of the population. Applying this to the size of the basic pension, this would lead to a zero pillar of only 30% of total pensions, leaving an overexposure of 55% to financial risks, matched by the same underexposure in absolute terms of the younger generations. If pensions are means tested, the zero pillar would be even smaller.

Also the tax and welfare system contributes to risk sharing, however. In particular, by taxing funded pension benefits,[16] the government in fact takes over financial risk from the retirees. At the same time, the government subjects the elderly to human-capital risk because taxes and transfers other than pensions depend on wages and the general state of the government budget.

To fill the gap between the human-capital exposure through the basic pension and the optimal exposure to human-capital risk, the government could issue wage-linked bonds up to 55% of total pension wealth – – on account of the younger generations and to be held as part of

[16] This assumes that the government taxes pension savings on a cash-flow basis, *i.e.* according the so-called EET system. The EET system exempts (E) contributions and returns and taxes (T) benefits.

the pension wealth of the retirees. This is quite substantial, however. In the Netherlands, for example, total pension wealth can be roughly estimated at 200% of GDP (65% for the public pension and 125 % wealth of pension funds, neglecting individual pension savings). A share of 55% wage-linked debt would represent about 110% of GDP well above actual public debt, and also by far exceeding the ceiling of 60 % for public debt in the EMU area. Naturally, this 55% concerns gross debt in wage-linked bonds. This exposure can also be reached by buying equity and corporate bonds and issuing wage-linked bonds, or equivalently by swapping fixed interest payments with wage-linked payments.

There are several qualifications to these figures. First, these calculations may overestimate the actual need for wage-linked bonds as the desired 85% wage-linked share of financial wealth concerns the decumulation phase only. However, also older workers demand positive amounts of human-capital exposure in their pension wealth, which may be quite substantial. All individuals of 32 years and older feature a net underexposure of human capital according to the standard life-cycle using the same shares of aggregate financial and human capital (see Bovenberg and van Ewijk 2011). Second, a substantial share of financial wealth is not related to life-cycle saving but owned by rich individuals who intend to leave bequests. These dynasties can engage in optimal risk sharing. To illustrate, in case of an adverse financial shock, these wealthy individuals could reduce bequests by 85% of the shock in accordance with the optimal exposure of future generations. Third, corporate bonds are a good substitute for wage-linked bonds in case of the pension wealth of retirees who typically hold pension claims with only a short duration. And finally, as mentioned above, also the tax system may contribute to the redistribution of risks across generations.

Table 2 Optimal risk sharing and the size of pillars in alternative pension models during the decumulation stage

	State	Market	Corporate	Liberal
pillar 0 *basic pension, public*	30% wage-linked	30% wage-linked	30% wage-linked	30% wage-linked
pillar 1 *earnings related, public*	55% wage-linked	[a]		55% wage-linked[b], 15% financial risk
pillar 2 *earnings-related, private*			55% wage-linked[c], 15% financial risk	

pillar 3 *individual savings*	15% financial risk	55% wage-linked bonds, 15% financial risk		

[a] Optional: limited wage-linked 1st pillar up to modal income.
[b] Through limited 1st pillar, or private pensions backed by wage-linked bonds).
[c] Open accounts or wage-linked bonds + wage-linked bonds.

Liberal model

In the liberal model, earnings-related pension savings are typically modeled as individual accounts managed by the private sector. Consumers can choose between alternative pension providers. Accordingly, pension funds cannot commit workers to intergenerational risk sharing and cannot tax quasi rents. Hence, pensions are based on financial assets traded in the financial markets only, so-called 'closed accounts' (see Bovenberg and van Ewijk, 2011). This model thus faces similar constraints as the market model in creating the optimal exposure of retirees to human-capital risk (and the corresponding optimal exposures of workers and future generations to current financial-market risks).

Several alternative options facilitate intergenerational risk sharing by increasing the human capital exposure of pensioners. First, as in the market model, the government can issue wage-linked bonds up to 55 % of total pension wealth of the retirees to be held by pension funds that provide wage-linked pensions or individuals in personal pension plans. Second, the government could organize a substantial part of earnings-related pensions, which are linked to wages, or provide other types of benefits to the elderly that are linked to wages (*e.g.* health benefits). This 'first pillar' should then make up to 55% of total pension income (and almost 80% percent of earnings-related pensions) for those income earners who do not leave intentional bequests to their offspring. Third, the government can increase the human-capital exposure of retirees by having tax rates on retirees decline with wage income. At the same time, the exposure of the retirees to financial risks can be reduced by taxing the pension benefits from funded systems according to the EET system and using the revenues to provide wage-linked benefits.

These options are by no means exclusive; all kinds of combinations are possible. For example, the government may provide a small earnings-related public pension (first pillar) up to, for example, the modal wage. This is in fact close to the actual US system. The idea is that those earning more than the modal wage can engage in intergenerational risk sharing through their bequest behavior.

State model

In the state model, life-cycle saving is fully mandatory and managed by the state. Individual savings in the private sector are limited to bequest saving only. The government raises taxes on wages, profits and private capital income, and uses the proceeds to provide pensions to the retirees. For optimal risk sharing the government should use the tax system to eliminate the over-exposure to human capital risk of the young and the over-exposure of financial market risk of the old. Pensions should be linked to human capital risk and financial risk in proportion to the shares of H, U and F to total wealth, in our example 20, 65 and 15%. For generations with positive human capital the role of the government to raise the exposure of human capital (H) decreases accordingly and it will become negative for the younger generations.

For the youngest generation with no financial capital at all, the government should increase their exposure of financial risks to F/W (here 15%), and decrease the exposure to permanent shocks in human capital by this same amount. This can be done by taxing wages by 15% and providing to the same generation a transfer that is linked to the return on financial capital. For temporary shocks limited to human capital of current generations, higher marginal tax rates are necessary. Alternatively, taxes (and transfers) should depend on the state of the economy.[17] Marginal tax rates on wages are often already quite high for reasons of intragenerational distribution, – often 50% or higher. This is too high from the perspective of permanent shocks, but this can be compensated when also transfers to these generations are linked to wages. For temporary shocks, the over-exposure of younger generations to these wage shocks can be eliminated by making the net benefit of these cohorts dependent on the state of the economy.

Aggregate risk on the state's balance sheet matches the aggregate under- and over-exposure of the current generations. This implies that the government should take sufficient risk of future generations on its balance sheet, while it should go short in human capital of current generations. Furthermore, it should take sufficient financial risks on its balance sheet. As private life-cycle savings are absent in such a world with state-organized pensions, the government should have accumulated sufficient financial wealth,[18] part of which could be invested in risk-bearing assets. In the same vein, a special social security trust fund[19] could hold part of its portfolio in equity.

Taking capital market risk on the government balance was the first step; the next step is to transfer this risk to young workers. This can be done by financing shocks in the government's net wealth by adjusting labor-income taxes or spending categories that benefit the young. Alternatively, the government can adjust the pension accumulations of the workers in NDC accounts. Agents with human capital thus become the residual risk bearers of the capital risks that the government takes on. The government in effect acts as the representative of the younger households in taking on more capital risks, which young individuals cannot take on directly.

Corporatist model

In the corporatist model, earnings-related pensions are mandatory and organized by private occupational pension funds. The role of the state is limited to providing a basic pension (zero pillar). Voluntary individual pension plans (third pillar) play a minor role because occupational pension plans, which are part of the labor contracts of workers, provide quite ambitious earnings-related pensions. In the Netherlands, for example, occupational pension plans aim at a replacement rate that exceeds 70% at the age of 65. If retirees do not have other types of saving and do not plan to leave bequests, optimal intergenerational risk sharing implies that the financial risk exposure of the pension wealth of pensioners should amount to only 15%. With a basic pension representing 30% of pension wealth, this implies that occupational pensions paid to retirees should be linked to (permanent) wages for 55/70 and to financial risk for 15/70. For

[17] For medium-term shocks that affect human capital of this generation only and leave the human capital of future generations unaffected, the tax rate should be $(U+F)/W$. In our benchmark, this share amounts to 80%).

[18] We assume the intergenerational distribution to be equal for all pension models. That means that government savings in the 'state model' should be equal to private savings in the 'market model'.

[19] The government fund does not have to be earmarked for public pensions and can also be used for general revenue purposes.

workers who still have human capital the share of pension wealth linked to financial returns can be larger. Indeed, young workers may want to bear substantial equity risk.

4.3 Three types of accounts

This hybrid system of wage-indexed pensions and pensions indexed to financial returns, can be organized through 'closed accounts', matched by wage-linked bonds provided by the government, or by 'open accounts.' In the latter case, pension funds bear the residual risk on account of future generations. This allows pension funds to engage in intergenerational risk sharing even in the absence of wage-linked bonds. Pension funds can exploit the rent on specific human capital to tax workers, but only up to the maximum of these rents. Imperfect portability of pensions or intransparency of pensions may impede mobility of workers, and thus increases the scope for risk sharing. By way of compromise, collectively closed accounts allow for trade of risk between current participants of the pension fund, while leaving no net mismatch risk to the fund in the aggregate. This reduces the danger of discontinuity – and the consequential need for solvency requirements – which is intrinsic to open accounts. We will briefly discuss each of these alternatives.

Closed individual accounts
With closed individual accounts, pension funds do not take any risk on their balance sheets. Intergenerational risk sharing occurs by taking the optimal amount of financial assets and (wage-linked) bonds in individual portfolios. The share of (wage-linked) bonds increases with age. For pensioners it should be 55/70 in our example, assuming that additional individual savings in the third pillar are absent, and that the government provides a basic pension up to 30% of total pensions. If these third-pillar savings are present, the investment behavior of pension funds is less relevant because agents use their third-pillar investments to achieve optimal risk exposures. For closed individual accounts to accomplish optimal intergenerational risk sharing, governments, which tax labour income and thus address the limited liability of human capital, must issue wage-indexed bonds.

Open accounts
In the absence of wage-indexed bonds, pension funds can contribute to risk sharing by issuing wage-linked assets on their own account in the form of pension promises that are (partly) indexed to wages. In this case, individual accounts are open in the sense that individual property rights of participants take the form of claims on the pension fund rather than tradable financial securities. The risk features of individual pension claims are now implied by the policy of the pension fund with regard to premiums, pension payments and investments. By issuing liabilities on their own accounts, pension funds are involved in the transformation of risks. Indeed, the risk characteristics of the liabilities of the pension funds are not spanned by tradable financial assets.

The optimal mismatch risk on the balance sheet of the pension fund may be substantial. To illustrate, taking the distribution of 85% human capital risk and 15% financial risk as starting point, an unexpected decline of 10% in financial assets that is uncorrelated to human capital should ideally reduce the claims of retirees on the pension funds by only 1.5%. The rest of the

shock is shifted to younger generations and future generations: a share of 20% of the shock is borne by younger generations, and as much as 60% of the decline in wealth is shifted to future generations in the form of a lower buffer. The pension funds, however, can trade risks with future generations up to the limit that is implied by rents on specific human capital of the workers. It seems therefore natural that also the government engages in intergenerational risk sharing, and takes the larger part of the burden.

Solvency requirements should find a balance between minimizing discontinuity risk and thus ensuring that funds can meet their promises while at same time maximizing the scope for intergenerational risk sharing. Risk sharing requires that shortages (and surpluses) can be carried over to the future as much as possible. Containing discontinuity risk, in contrast, requires that the largest burden of recovery should be put on the short-term or medium term, as current workers – who have already built up their specific human capital – can be taxed more easily than future workers. In view of its power to tax labour income in the country as a whole, the government seems typically more powerful than pension funds in facilitating intergenerational risk sharing. Nevertheless, pension funds may play a welcome, complementary role in assisting intergenerational risk sharing because pension funds and the government may face different strengths and weaknesses.

Collectively closed accounts

Under collectively closed accounts, the pension fund may organize risk sharing between participants of the fund but without taking any net aggregate risk on its balance sheet. The pension fund can thus trade for example human capital risk and longevity risk between its current younger and older members, even in the absence of wage-linked bonds and longevity bonds on open markets. This may fulfill the need for wage-linked bonds and longevity bonds to some extent, but far from what is needed in total, leaving an important role for the government. In particular, pension funds are unable to organize risk sharing with future generations; this becomes an exclusive task for the government under this solution.

4.4 Optimizing life-cycle planning and insurance

The second dimension of pension systems involves the trade-off between compulsion and choice (or containing personal failures versus tailoring to heterogeneity, see Table 1). All systems face growing heterogeneity and more demanding consumers (see Section 2). There is no easy way to get around the trade-off between choice and compulsion. Yet there may be scope for improvement. First, mandatory pensions (*i.e.* the first and second pillars, which are dominant in the state and corporatist models) could tailor more to individual heterogeneity. This requires governments and pension funds to gather information on individual circumstances such as household composition, career, housing status. Second, one could allow for more elements of choice within mandatory systems, for example in adjusting contributions, investment portfolio, moment of retirement, and type of annuity. Third, the literature on behavioral finance (see Thaler and Sunstein, 2008; Bodie and Prast 2011) suggests that scope for substantial improvement exists by guiding individual choice using defaults. Structured choice through defaults may result into some convergence of various pension systems; defaults may guide individual choice in individual schemes (which are dominant in the market and liberal models)

while also allowing some degree of choice in collective schemes that previously did not allow any individual choice (these systems are dominant in the state and corporatist models). Fourth, the government can support private savings and investment decisions through the tax system. Finally, flexible retirement systems and housing arrangements could also contribute to life-cycle planning.

Integrating pensions with life-cycle savings

The ICT revolution, which is still in its infancy, will open up vast new opportunities to collect data on the features of individuals, thereby allowing mandatory systems to tailor pensions and social security to the individual. However, privacy considerations and fears about a 'big brother' type of pension agency may prevent the potential of ICT from being fully exploited under all models. At the same time ICT may also improve individual decision making by making markets transparent and supporting complex decisions on life-cycle planning by *e.g.* expert systems (see also Ter Weel *et al*., 2010), who sketched alternative scenarios for future social security systems depending on information and communication technology).

Heterogeneity, borrowing constraints, and size of the pillars

Despite the scope for improving individual information, it will be impossible to tailor pensions perfectly to individual features and preferences. Some information may remain hard to observe by pension agencies, and agents may be reluctant to sacrifice privacy. Therefore, mandatory systems will continue to be subject to asymmetric information. This implies that there should be some scope for individual choice. With incomplete markets, individuals cannot undo the public arrangements (except redistribution) by private transactions in financial markets. In particular, many agents – especially with lower incomes – face borrowing constraints and thus have little or no access to financial markets. These individuals will therefore be unable to tailor their pension savings to their personal circumstances and preferences. Accordingly, the welfare costs of 'too high' and 'too low' mandatory pensions are asymmetric, Whereas rational agents for whom mandatory pension savings are 'too low' can easily compensate this by additional voluntary saving, agents who are forced to save too much cannot compensate this by additional borrowing. As the cost of excessive pensions thus exceeds the cost of too-low pensions from an individual perspective, mandatory pensions should always be smaller than average pensions in the optimum. This would lead to replacement rates for mandatory pensions of well below 100%, especially since optimal consumption after retirement is typically less than consumption earlier in the life cycle. Pension ambitions in mandatory systems may thus be considered to be too high in some mandatory systems – – for example, in the Netherlands.

Four scenarios for the future pension system

By including the 'heterogeneity' dimension of the pension system, Table 3 extends Table 2, which focused on intergenerational risk sharing only. Table 3 thus summarizes alternative models for the future pension system. We will briefly discuss this second dimension for each model, in the same order as in the previous section.

Table 3 Multi-pillar pension systems

State	Market	Corporatist	Liberal
pillar 0: social pension			
public	public	public	public
pillar 1: earnings-related pension			
comprehensive public system, integrated with social and health insurance			[a]
pillar 2: supplementary private earnings-related pensions			
		earnings-related pension organized by pension funds, mandatory and employer-related[b,c]	flexible earnings-related occupational pensions[d] free choice of provider, under regulation
pillar 3: voluntary individual savings			
limited: for bequests and for supplementary savings	precautionary savings through voluntary pension plans supported by education and information (ICT), and light regulation	[e]	limited role (mainly for bequests)
pillar 4: non-financial assets			
[f]	basic public provision of health care, life-cycle products (*e.g.* reverse mortgages), informal care	[g]	tailored public provision of health care and housing, informal care

[a] Optional: basic public earnings-related pension.
[b] For the middle incomes, closed accounts supported by indexed bonds or collectively closed accounts.
[c] Optional: basic earnings-related pensions (wage-linked) to create scope for individual choice in the third pillar.
[d] Closed accounts supported by indexed bonds.
[e] Optional: supplementary individual savings, guided by strong regulation on internalities (defaults etcetera) and market failure (*e.g.* standards, public procurement).
[f] Health care, training, housing and social security together with pensions integrated in encompassing welfare system; cradle to grave: limited role for informal old-age care.
[g] Optional: health insurance, training and home-ownership (mortgages) into pensions, but at some cost (loss of competition) limited role for informal old-age care.

Market model

The market model features low mandatory saving and leaves ample scope for individual choice. However, a small mandatory earnings-related pillar seems called for to address individual failures, facilitate intergenerational risk sharing, prevent selection in insurance, and avoid moral hazard as a result of means-tested benefits (since most benefits are means-tested in this model).

Defaults at the employer level may be an attractive solution here to guide individual choice and fight adverse selection while still allowing individuals to tailor individual arrangements to individual circumstances. By issuing tradable wage-indexed bonds rather than large non-tradable, mandatory wage-indexed public pensions, the government allows individuals to select their own portfolios and tailor them to individual circumstances. Individuals may want to keep a substantial part of their life-cycle savings in liquid form because precautionary saving is important in the face of limited public insurance of human-capital risk during the accumulation phase and health risk during the decumulation phase. Financial innovation may also allow housing wealth to play an important role in insuring old-age risks. Flexible retirement and labor markets may help individuals to absorb risks.

Liberal model

Compared to the market model, the liberal model allows the government to set more defaults and even a mandatory level of earnings-related pension insurance. Thus, many defaults in pension insurance are set by the government rather than the employers. Moreover, the government may want to provide a higher level of non-tradable earnings-related pension claims, for example up to the modal wage. The government also is active in regulating the market for personal pension plans. It provides wage-linked and longevity bonds to help private insurance companies offer defined-benefit type pensions that tailor to the specific preferences of retirees during the decummulation stage. The government similarly regulates healthcare.

State model

Better tailoring of pension contracts under mandatory public systems requires the state to gather more information about specific relevant features of its participants: not only the individual's earnings history and family status, but also information on the individual's health, financial portfolio, housing status (home-owner or renter), and preferences with regard to risk and time. The state model may thus develop into a integrated life-cycle system closely monitoring all individuals. The state thus provides not only pension insurance but also health insurance and other insurances of human capital, such as disability and unemployment insurance. If ICT reveals more specific risk features of individuals, insurance possibilities shrink as insurance becomes redistribution. The state model is well placed to replace insurance by redistribution. This requires, however, more restrictions on individual choice.

Corporatist model

Similar to the state model, the corporatist model may develop into a comprehensive mandatory life-cycle system for workers employed in a particular sector or firm. During the accumulation phase, pension contributions may be complemented by training and other types of insurances of human capital such as disability and unemployment insurance. During the payout phase, health insurance and housing provisions may complement annuities.

Alternatively, the corporatist model may limit its ambition to create more scope for choice in individual pension plans (third pillar). In the latter case, use of individual information by pension funds and insurers may be forbidden for example to prevent risk selection by insurers or for reasons of creating level playing field between market (insurers) and non-market parties (pension funds).

5 Conclusions

Although each prototype model discussed in Section 3 can in principle perform all functions of the pension system, there are important differences. The two mandatory systems – state and corporatist – are better geared toward solving problems of adverse selection, while the systems relying more on consumer sovereignty – liberal and market – are better able to deal with unverifiable heterogeneity across individuals. As regards the function of intergenerational risk sharing, the state systems – thanks to their power to tax – are better able to commit young generations to intergenerational risk sharing. This makes it also possible to redistribute human capital risks from the young to the old by indexing pensions to wages, which is not possible in the market model. Also other macroeconomic risks such as longevity risk and risks concerning future production can be more easily shared between multiple generations in the state model.

State-based systems tend to have problems in sharing financial risks. Redistributing these risks from the old to the young requires that the state takes substantial financial risks on its balance sheet. Active financial risk management by the state on the basis of a large portfolio of financial claims is rare, however, except for countries with large positive government wealth (*e.g*. Norway). In order to contain political risks, governments typically hold only a very restricted portfolio, consisting of nominal and sometimes real bonds only. Privately oriented pension systems, such as the corporatist and the market model, are better equipped for sharing financial risks. The same holds true for the liberal model because it relies on saving through private pension funds.

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